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The Institute of British Foundrymen

The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

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J. Hepworth, J.P., M.P., "Ingle Nook," Bolton Road, Bradford.

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The Bradford Conference

Viewed from no matter what angle, the Bradford Conference of the Institute of British Foundrymen was an unqualified success. That there was some opposition to the proposed alteration of the bye-laws merely signifies that there are two schools of thought, each having the welfare of the Institute at heart. The matters at issue are well known, and opinion is somewhat divided as to which policy will ultimately best serve the Institute, and through it the industry. The new President, Mr. Joseph Hepworth, J.P., M.P., who has achieved eminence in the public life of this country, is well qualified to lead the Institute into making a wise decision. His inaugural address, by directing the attention of the foundry industry to the potentialities of the export trade and of their special importance within the Empire, will merit the close attention of the industry's executives. A major problem of the next few decades will be as to how the competition from the rice-eating nations can be met and overcome.

The Papers covered a particularly wide field, ranging from specialised methods of manufacturing and metallurgical control to shot-blasting. By a happy coincidence, both the French and German Exchange Papers dealt with the subject of light alloys, and Mr. Gürtler, who presented the latter, was able to throw light on Continental practice generally. A good deal of the discussion on Mr. Blakiston's Paper centred round the addition of relatively small quantities of thin steel sheet or the like to molten cast iron, it being thought to have an ameliorative effect. It was somewhat reminiscent of Mr. Judson's Paper of two years ago, when he touched upon the mixing in the liquid condition of two grades of cast iron.

From a social standpoint, the Bradford Conference was an outstanding success. The civic authorities contributed very materially to this, for not only did they accord, through the courtesy of the Lord Mayor and Lady Mayoress, a civic reception, but they had the cordial co-operation of the Parks and Education Committees. The former made the various meeting places a blaze of colour by the floral decorations, and the latter organised a conversazione at the Technical College, which institute also provided an ideal lecture theatre for the holding of technical sessions.

The honours distributed this year were well merited. The Institute's best friend, Mr. E. J. Fox, becomes an honorary member, and his chief metallurgist, Mr. S. E. Dawson, by pure coincidence, was awarded the Oliver Stubbs Medal. Mr. Dawson was the inventor of "Nomag" cast iron, which to-day is so largely used in electrical engineering. The second recipient of the E. J. Fox Medal was Mr. J. E. Hurst. Mr. Hurst was a pioneer in the development of centrifugal castings, and latterly has done much to show the potentialities of heat-treatment of cast iron.

A feature of the Conference was the interest which centred around the works visits. Generally speaking, all the foundries visited were of a specialised character. Hepworth & Grandage, who make single cast piston rings, have introduced into their control system a maximum of cleanliness in manufacturing operations. This feature so impressed the visitors that repercussions of an ameliorative character can be expected to affect the whole foundry industry. The visit to Broadbents, of Huddersfield, was noteworthy because of the success of the sand control system as applied to jobbing foundries. Modern Foundries was outstanding because of such unusual features as the intensive use of the pulverised-fuel-fired rotary furnace, combination moulding methods and dirt removal. Hopkinsons, of Huddersfield, must be congratulated on their methods of handling sand for steel castings production, their intelligent operation of the oil-fired converter and the organisation of their fettling shop. John Fowler, of Leeds, is particularly interesting at the moment, as it is in the midst of a reorganisation of the foundry. Certain steps have already been taken and are already bearing fruit. Real progress has been registered in the making of Diesel engine castings. Blakeboroughs, of Brighouse, have a foundry presenting a maximum of interest. They are Meehanite licensees; they have a mechanised section, and there is an excellent system of handling raw materials. Prince-Smith & Stells, of Keighley, have their foundry divided up into a number of manufacturing sections carrying certain common services. It is so well organised that it poses a problem to those who would mechanise the industry, as to whether any financial benefits would accrue. The same remark applies to Fairbairn Lawson Combe & Barbour, of Leeds, who are the largest manufacturers of jute making machinery in the country. Much thought has been given to the making of each type of casting and probably something like the best has been discovered To the directors and staffs of these concerns the members of the Institute are indeed grateful, not only for opening their foundries for inspection, but for permitting us to describe them for the benefit of a wider public.

For the organisation of this successful Conference the thanks of the participants are due to

(*Concluded on page* 494.)

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Is the Boil Important?

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In reply to the letter from Mr. D. W. Evans appearing in THE FOUNDRY TRADE JOURNAL of June 2, the authors would state that the words, "is the boil important?" did not appear in the Paper as read. Mr. Evans states that the boil is necessary where any refining has to be done, but that depends upon the amount of refining required. It should be understood that the authors were referring to the vigorous boil induced by the addition of iron ore. They stressed the importance of scrap being controlled to sulphur and phosphorus maximum limits in the partial oxidation process.

They do not agree that all the authorities look forward to the "boil" to drive heat into the metal; some of them, at least, look at it from a totally different viewpoint, i.e., the elimination of hydrogen by the introduction of a larger volume of carbon monoxide than is possible without the use of ore. But does not that suggest the question, "Is the cure worse than the disease?" Apart from that, the flexibility of the electric furnace should obviate any necessity for dependence on reaction heat in the production of steel for castings. The authors find the rust and scale adhering to the scrap adequate for oxidation purposes, as the following typical bath sample taken before the reducing slag was put on will show:—C, 0.06; Si, 0.093; Mn, 0.11; S, 0.047, and P, 0.022 per cent.

Not having 50 per cent. shop scrap to use, the authors' charges have a much larger proportion of good plate scrap and turnings than Mr. Evans. Admittedly, the complete oxidation process has advantages where scrap is not controlled, but it also has disadvantages, and in the authors' opinion the latter predominate. The risk of over-oxidation is not eliminated even when manganese scrap and carbon are included in the charge.

If oxidation with iron ore could be gauged to such fine limits that the melter could be relied on to use it with the discretion necessary to prevent the possibility of excess of dissolved oxides, then there would be less objection to its use. Efficiency in oxidation governs the quality of steel made in the electric arc furnace.

Steels with excess of dissolved oxides do not deoxidise satisfactorily and are invariably low in fluidity. It follows that with controlled scrap and restriction of oxides there is a greater possibility of producing better quality steels regularly. Further, iron ore is not exactly a "panacea" for basic bottoms. In conclusion, we would say that some of the more common defects met with in steel castings are traceable to over-oxidation.

Yours, etc.,
JOHN E. MERCER.
D. K. BARCLAY.

Teesdale Ironworks.
June 15, 1938.

Some Factors in Sand Testing

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In his Paper, "Some Factors in Sand Testing," Mr. T. R. Walker refers to the double-compression method of making the test-piece. The ramming of the test-piece to the correct length *by means of blows on each end* seems to be common practice, but this is wrong, and, as the name indicates, the test-piece should be made by *squeezing* down the pistons one after the other.

The use of blows of a mallet produces uneven ramming, and the point is not so trivial as it may seem.—Yours, etc.,

WM. Y. BUCHANAN.

John Lang & Sons,
Johnstone.
June 13, 1938.

Catalogues Received

Sand Preparation. In connection with the twenty-fifth anniversary of the establishment of their company, the National Engineering Company, of Chicago, Illinois, U.S.A., have issued a particularly attractive catalogue dealing with *inter alia* the Simpson intensive mixer. First of all it enunciates the principle of mixing by mulling, that is milling involving a combination of applied pressure and slippage, effected by the combined action of the rollers and ploughs. The latter by a shovel-like action turn over the sand and place it beneath the roller, which does not ride on the surface of the pan. It might be thought that such a mill was limited to batch making, but by the judicious installation of batch hoppers both before and after mixing the sand, continuity is ensured whilst retaining the advantages of definite batch control. All this and similar germane matter is well brought out in this 48-page well-illustrated brochure.

As is well known, the Simpson mixer and related plant is manufactured and distributed to the British Empire by Augusts, Limited, of Halifax, who this year also celebrate the twenty-fifth anniversary of their establishment. To both these enterprising firms we offer our hearty congratulations and wish them continued success.

Fans. A general-purpose catalogue has been received from Davidson & Company, Limited, Sirocco Engineering Works, Belfast, entitled "Fans and Facts." The illustrations have been chosen to emphasise the catholicity of their dust-extracting plants, and cover food products, coal, soap making, food manufacture, etc. Advantage has been taken to emphasise the extremely important position the firm occupies in this particular field. A number of different types of fans are described and illustrated in such a way as to make the catalogue interesting to the layman.

Publication Received

Fuel Oil in Industry, No. 2.—Non-Ferrous Foundries. Issued by Shell-Mex & B.P., Limited, Fuel Oil Department, Shell-Mex House, London, W.C.2.

This exceedingly well-illustrated and intelligently written brochure focuses attention to the potentialities of oil as fuel for consideration by non-ferrous foundry executives. By means of illustrations carrying five to ten line captions, the reader is taken from bale-out furnaces, rotary furnaces, both plain and recuperative, lift-out and tilting crucible furnaces, to ladle and core drying. On the back page a useful table is printed which correlates varying prices of oil fuel with the cost of 100,000 B.T.U. The brochure discloses that the issuing house has thorough knowledge of the non-ferrous foundry industry, and presuming that it possesses similar information about the iron foundry, then a further brochure covering this section would indeed be equally welcome.

The Bradford Conference

(*Concluded from page* 493.)

the members of the local reception committee—Mr. S. W. Wise, the honorary secretary of the local Branch, Mr. H. Forrest, Mr. A. S. Worcester and Mr. W. G. Thornton. They have indeed rendered yeoman service, and if as a result of this manifestation there results an increase in membership and interest in the work of the West Riding Branch, it will be but a fitting reward.

In tendering to the President and his two Vice-Presidents our heartiest congratulations, we wish them every success in their strenuous endeavours to stage next June an equally successful International Conference.

Random Shots

Whatever preconceptions one had of a Northern industrial town as a gay and salubrious centre for a conference, the Bradfordians certainly did their best to dispel them with their hearty welcome and a brave show of flowers. The floral decorations everywhere were beautiful, and the 1938 Conference will leave behind it a very pleasant odour—that of flowers and good cheer. Mr. Spring, by the way, although somehow systematically missed out of the list of overseas visitors to the Conference, can rest assured that he was as welcome as the flowers that bloomed, not in the spring, but at the Conference! The fact that the Test Match was only a draw had nothing to do with it. In fact, that Mettered little during those few busy days, when it was as much as one could do to find time to wash down the higher mathematics of foundry work with lashings of Tetley's, and change in time for dinner.

* * *

Whilst taking a breather (so necessary yet so rare during conferences) in one of Bradford's "sparrow parks," a little bird told "Marksman" the following story. Mr. Hepworth has installed himself in a new house which is called "Inglenook." This name somehow failed to please Mr. Hepworth, so he decided to change it to "The Cloisters." "And why 'Cloisters'?" people asked. "Well, you see, its cloise t' pub, cloise t' church, and cloise t' fish and chip shop."

* * *

A day or two later, whilst lunching at a snack bar (in a desperate effort to make up for time spent in Bradford previously), "Marksman" came across a special type of sandwich called a "Bradford Lad." It was a cream-cum-strawberry-jam affair, which somehow seemed more reminiscent of Bradford lassies than the lads!

* * *

Talking of sandwiches recalls another story told of the Empire Exhibition. A visitor inquired for the Peace Pavilion—and the girl attendant replied: "Is it a jam sandwich ye would be needing the noo?" In Scotland, apparently, the homely bread and jam is called a piece. In France they call it a tartine, which is just another example of the similarity of the two languages, because so many of the Scottish tartans look for all the world like a messy piece of bread and jam!

* * *

A man called at the house of a friend to congratulate him and his wife on the arrival of their twelfth child. On seeing a curious looking bird in the garden, he inquired if it were a rare species of duck. "Duck? No, man, that's a stork with its legs worn down!" explained the parent.

"MARKSMAN."

Pig-Iron and Steel Output

The British Iron and Steel Federation state that there were 105 furnaces in blast at the end of May, compared with 111 furnaces at the end of April, seven furnaces having ceased operations during the month, and one having resumed production. The production of pig-iron in May amounted to 633,900 tons, compared with 660,000 tons in April. The output of steel ingots and castings in May was 957,000 tons, representing approximately 81 per cent. of maximum monthly output reached in November last. The output was higher than in April, when it was 938,000 tons; but the daily average output in May at 36,500 tons was somewhat lower than in April, although representing an operating rate on the basis of 300 working days of over 11.04 million tons per annum.

ANNUAL GENERAL MEETING

The first function of the Bradford Conference was the thirty-fifth Annual General Meeting of the Institute, held at the Bradford Technical College on Tuesday, June 14. Mr. C. W. Bigg (retiring President) presided, and was accompanied on the platform by Mr. J. Hepworth, J.P., M.P. (President-elect), Mr. W. B. Lake, J.P. (Vice-President); Mr. S. H. Russell (Hon. Treasurer and Past-President); Messrs. F. J. Cook, V. C. Faulkner, A. Harley, V. Stobie, Roy Stubbs, J. E. Hurst and H. Winterton (Past-Presidents), and Mr. T. Makemson (General Secretary).

The minutes of the preceding Annual General Meeting, held at Derby in June, 1937, were taken as read, confirmed and signed.

ANNUAL REPORT

This report covers the period May 1, 1937, to April 30, 1938, and the Statement of Accounts for the year ended December 31, 1937.

The past year has been one of the most successful in the history of the Institute. The record membership announced twelve months ago has been substantially increased, and is now 2,220; the finances are in a sound condition, and every department of the Institute's work has made progress. This happy position is due largely to a recognition of the increasing value of the Institute to the industry, and to a rapidly growing recognition by the individual foundryman of the value of membership.

Table I shows the changes in membership which have taken place during the year, and an analysis of the present membership is given in Table II, the figures for the previous year being given in brackets for comparison.

Deaths

The Council regrets to report the deaths of fourteen members. Included in this number are many who had taken an important part in the work of the Institute and were widely known throughout the industry, including:—

Mr. G. B. R. Taverner, a well-known member of the London Branch.

Mr. T. B. McBride, of Wallsend-on-Tyne, who at the time of his death was Senior Vice-President of the Newcastle Branch.

Mr. H. Stead, a former secretary, and at the time of his death the assistant secretary, of the Lancashire Branch.

Major R. A. Bull, of Chicago, who was a prominent member of the American Foundrymen's Association, and a member of this Institute since 1922. In 1923 he presented the American Exchange Paper to the Annual Conference of the Institute.

Mr. J. B. Johnson, a Past-President of the Birmingham Branch.

Mr. G. H. Oxley, a prominent member of the Sheffield Branch.

Mr. F. Bainbridge, a member of the Middlesbrough Branch, and a Carnegie Gold Medallist of the Iron and Steel Institute.

Mr. E. H. Tyson, a well-known aluminium founder and a Past-President of the Birmingham Branch.

MR. J. HEPWORTH, J.P., M.P.
(*President of the Institute*).

Although not actually members of the Institute, several notable gentlemen associated with the industry have died during the past twelve months, and of these the following were particularly well known to many members:—

Sir John Dewrance, G.B.E., Past-President of the Institute of Metals and of the British Cast Iron Research Association, who, at the 1929 International Foundry Congress in London, entertained the participants at a reception at the Guildhall.

Mr. G. Batty, a pioneer of electric-furnace steelmaking, and a well-known figure both in American and British steel-foundry circles.

Mr. T. E. Bashford, a founder and former treasurer of the Middlesbrough Branch.

Honours Conferred upon Members

Among the members who have been honoured during the past twelve months are:—

Mr. P. M. Booth, who was knighted by His Majesty the King, at the time of the Coronation last May.

Professor Dr. Mont Fr. Pisek, who was decorated by the French Government with the Cross of Chevalier of the Legion of Honour.

Sir Harold Carpenter, F.R.S., Ph.D., who received the Gold Medal presented by the Verein Deutscher Eisenhüttenleute.

Mr. C. W. Bigg, President of the Institute, who was elected a patron of the Derby Society of Engineers.

Mr. W. J. Rees, who was re-elected President of the Refractories Association of Great Britain in May, 1937.

Mr. Frank Russell, who was elected President of the same Association in succession to Mr. Rees in May, 1938, a few days after the period officially covered by this report.

Mr. A. C. Turner, who was re-elected President of the Foundry Trades' Equipment and Supplies Association.

The Council is also gratified to note that Mr. A. Brizon, President of the Association Technique de Fonderie, has had the Cross of Chevalier of the Legion of Honour conferred upon him.

Finances

The rapidly-increasing membership has had its effect upon the finances; expenditure has naturally increased, but this has been more than compensated for by the increased income. The excess of income over expenditure for the year ended December 31, 1937, amounted to the handsome sum of £372 9s. 3d., which is the largest credit balance for any year since 1922.

Technical Development Fund

At the opening meeting of the Derby Conference, the President announced the presentation by his co-directors of Qualcast, Limited, and himself, of the sum of £500 to form the nucleus of an endowment fund to be used for the promotion of the work of the Education and Technical Committees. The meeting gratefully accepted the generous gift and tendered its thanks to the donors. The Council now takes this opportunity to record its sincere thanks to the donors and its appreciation of this recognition of the value of the Institute's technical work.

At a meeting of the Council held in October, Mr. C. W. Bigg, Mr. J. Cameron, Mr. W. B. Lake, Mr. S. H. Russell and Mr. C. E. Williams were appointed Trustees of the Fund.

E. J. Fox Gold Medal

At the annual general meeting in June, 1936, the Council accepted the most generous offer of Mr. E. J. Fox, managing director of the Stanton Ironworks Company, Limited, of £500 for the establishment of a Gold Medal, which was to be presented to the individual who had contributed in some outstanding way to the progress of the foundry industry, with particular reference to foundry metallurgy. On the recommendation of the two assessors, Sir William J. Larke, K.B.E., and Prof. Sir Harold Carpenter, F.R.S., Ph.D., the Council decided to make the first award of the medal to Professor Emeritus Thomas Turner, M.Sc., "as a recognition of his work on the effects of silicon on cast iron, and his other contributions to the metallurgy of cast iron, which may be considered to have formed the foundation of modern foundry practice." The presentation was made at the Annual Conference in Derby last year.

This year the Council has accepted the recommendation of the assessors that the Medal be awarded to Mr. J. E. Hurst, Past-President of the Institute, to whom it will be presented at the Annual Conference at Bradford.

Awards

Oliver Stubbs Medal.—At the Conference held at Derby in June, 1937, the Oliver Stubbs Medal for 1937 was awarded to:—

MR. P. A. RUSSELL, B.Sc., "for his work in promoting the technical development of iron-foundry practice: (*a*) as Convener of the Cast Iron Sub-Committee of the Technical Committee; (*b*) for his work in connection with the preparation of specifications; and (*c*) for Papers given to various Branches of the Institute."

Diplomas.—At the Derby Conference last year it was announced that Diplomas for 1937 were to be awarded to the following gentlemen. The Branches before which their Papers were given are also shown:—

Mr. H. H. Shepherd, Birmingham and London Branches; Mr. S. A. Horton, East Midlands Branch; Mr. R. Ballantine, Lancashire Branch and Falkirk Section of the Scottish Branch; Mr. E. W. Wynn, Lancashire Branch; Dr. C. J. Dadswell, Mr. T. R. Walker and Mr. F. Whitehouse, joint authors of a Paper given before the Sheffield Branch.

Buchanan Medals and Prizes.—The Buchanan Medals and Prizes are awarded on the results of examinations organised by the City and Guilds of London Institute on Foundry Practice and Patternmaking. The names of recipients are given under the heading of "Educational Work" later in this report.

John Surtees Memorial Examinations.—These examinations were founded by Mr. W. Mayer, Past-President, in memory of the pioneer founder, John Surtees, who was connected with the Newcastle district. The examination is organised alternately by the Newcastle and Scottish Branches. This year the examination was held in Scotland, and the winner of the Senior Prize was Mr. A. M. Campbell, and of the Junior Prize, Mr. John Allan.

Branch Activities

Throughout the past year the Branches have been able to maintain the high quality of the programmes which are arranged. A large number of Papers have been presented covering all phases of foundry practice. An analysis of the subjects covered by the Papers shows that of the 77 contributions, 15 were on the subject of cast iron, 7 on steel, 6 on non-ferrous metallurgy, 1 on malleable cast iron, 9 on sand, 1 on refractories, 7 on the melting of metals, 2 on costing, 4 on patternmaking, 9 on general moulding practice, and 15 on general topics.

TABLE I.—*Changes of Membership*, 1937–38.

	Subscribing firms.	Members.	Associate members.	Associates.	Associate students.	Total.
At April 30, 1937	66	864	987	121	27	2,065
Additions and transfers from other grades	8	92	117	27	9	253
	74	956	1,104	148	36	2,318
Losses and transfers to other grades	1	30	51	11	5	98
At April 30, 1938	73	926	1,053	137	31	2,220

MR. W. B. LAKE, J.P.
(*Senior Vice-President*).

At the meetings which the Council has held throughout the year, it has been found that matters of a national and international interest have made increasing demands upon its time. It is realised, however, that the work of the Branches is of fundamental importance, and every effort has been made to give the maximum attention to this aspect of the Institute's work.

As was reported in the last annual report, a Branch has been established in South Africa, and, during the year under review, it has grown rapidly. A full programme of Papers was arranged for its winter session and there is every indication that this will develop into a most flourishing Branch. The two Sections, those in East Anglia and at Bristol, which were formed in 1936, are also making progress, and are now taking their full share in the work of the Institute.

The London and Birmingham Branches held a two-day joint meeting in Birmingham; joint meetings between other Branches have also taken place. The London Branch is to be congratulated on the enterprise which it has shown during the past twelve months in organising a Branch visit to Belgian foundries, and also for the tour of foundries in the West Country which it has arranged for May. The Lancashire Branch organised a very successful day visit to the works of Vickers-Armstrongs, Limited, at Barrow-in-Furness.

The Council expresses its thanks to all the Branch officials; to the authors of Papers; and the directors and staffs of works which have been visited by members of the Institute during the year.

Kindred Institutions

Apart from the many contacts which representatives of the Institute make with representatives of other similar bodies on numerous Joint Committees, there have been during the past year several joint meetings of the Branches with the corresponding local bodies of other institutions, notably the Institute of Metals and the Institute of Vitreous Enamellers.

As was reported in the last annual report, the Institute has co-operated with a number of other institutions of a similar character in establishing a Joint Committee on Materials and Their Testing. The First Conference under the auspices of the Committee was held in Manchester in October.

International Relations

The happy relations with foundry technical societies, which have been established for many years, have been maintained during the present year mainly through the International Committee of Foundry Technical Associations, of which Mr. V. Delport was President during the year 1937. A meeting of this Committee with Mr. Delport in the chair was held at the International Foundry Congress in Paris last June, and this Institute was represented by the President, Mr. V. C. Faulkner and the Secretary, who attended as Secretary of the Committee. A party of fifty members of this Institute, and ladies, attended this Congress, and the thanks of the Institute are extended to the organisers of the Congress, the Association Technique de Fonderie, and to Mr. A. Brizon, the President, for their hospitality.

Arrangements have been made for members to participate in the next International Congress, which is to be held next September in Warsaw. Members are reminded that the 1939 International Congress is scheduled for London. Many provisional arrangements have been made, and several of the Branches have promised to co-operate in arranging a post congress tour of

TABLE II.—*Analysis of Membership, April* 30, 1938.

Branch.	Subscribing firms.	Members.	Associate members.	Associates.	Associates (Students).	Total.
Birmingham	8 (7)	151 (135)	156 (144)	17 (16)	7 (5)	339 (307)
East Midlands	4 (3)	64 (55)	87 (89)	4 (4)	1 —	160 (151)
Lancashire	14 (14)	115 (109)	210 (200)	32 (25)	— —	371 (348)
London	9 (8)	187 (182)	117 (106)	6 (6)	— —	319 (302)
Middlesbrough	1 (1)	23 (24)	34 (33)	9 (6)	7 (6)	74 (70)
Newcastle	7 (7)	34 (32)	29 (30)	49 (47)	10 (10)	129 (126)
Scottish	6 (6)	104 (101)	191 (187)	7 (9)	2 (1)	310 (304)
Sheffield	7 (7)	96 (93)	67 (59)	2 (2)	1 (1)	173 (162)
South African	10 (8)	36 (27)	17 (14)	7 (2)	— —	70 (51)
Wales and Monmouth ..	2 (2)	44 (43)	50 (45)	— —	3 (3)	99 (93)
West Riding of Yorkshire ..	5 (3)	51 (40)	79 (69)	4 (4)	(1)	139 (117)
Unattached	— —	21 (23)	16 (11)	— —	— —	37 (34)
	73 (66)	926 (864)	1,053 (987)	137 (121)	31 (27)	2,220 (2,065)

British foundries. It is expected that the major details of the Congress, which will be held in June, 1939, will be available in the late autumn of this year.

The authors of Exchange Papers presented on behalf of the Institute to Overseas Conferences, were as follows:—

American Foundrymen's Association Convention, 1937, at Milwaukee.—Mr. J. Roxburgh.

International Foundry Congress, Paris, 1937. —Mr. H. H. Shepherd.

The authors of Exchange Papers at forthcoming Conferences will be:—

American Foundrymen's Association Convention, 1938, Cleveland—Mr. W. J. Rees.

International Foundry Congress, 1938, Warsaw.—Mr. B. B. Kent.

Association Technique de Fonderie, 1938, Lyons.—Mr. T. R. Walker.

Papers were presented at the Derby Conference on behalf of the American, French, and German Foundry Associations, and all these countries will be represented by the Papers to be presented to the forthcoming Conference at Bradford.

Foundry Exhibition

At the Foundry Exhibition, held in conjunction with the Engineering, Marine and Welding Exhibitions at Olympia, London, last September, the Institute organised a stand which was used extensively by members visiting the Exhibition. Useful work was done in interesting non-members in the activities of the Institute, and as a result a number of new members were obtained. An official visit was also organised to the Exhibition, and many members, including the President and Vice-Presidents, were able to attend. The thanks of the Institute are tendered to F. W. Bridges & Sons, Limited, the organisers of the Exhibition, for the facilities they gave so generously in connection with the stand, and also for the generous hospitality to the Council and members.

Educational Work

The Institute has continued to collaborate with the City and Guilds of London Institute in organising examinations in foundry practice and patternmaking. The following are the results of these examinations which were held at the beginning of last year.

	No. of candidates.	Pass 1st class.	Pass 2nd class.	Percentage of passes.
Patternmaking— Intermediate grade	30	8	13	70.0
Patternmaking— Final grade	23	11	5	69.5
Foundry Practice and Science	78	17	27	56.4

Prizes were awarded to:—

Patternmaking—Intermediate Grade:—

Mr. R. D. Cheyne, Constantine Technical College, Middlesbrough. Bronze Medal of the City and Guilds of London Institute.

Patternmaking—Final Grade:—

Mr. R. H. Francis, Coventry Technical College. City and Guilds of London Institute's Silver Medal, and Buchanan Book Prize of the Institute of British Foundrymen.

Mr. F. N. Rand, Constantine Technical College, Middlesbrough. Buchanan Silver Medal of the Institute of British Foundrymen.

Mr. S. Hodgson, Rotherham College of Technology and Art. Buchanan Book Prize of the Institute of British Foundrymen.

Foundry Practice and Science:—

Mr. W. C. Marshall, Derby Technical College. City and Guilds of London Institute's Bronze Medal, and Buchanan Silver Medal of the Institute of British Foundrymen.

Mr. J. D. Leishman, Sheffield University. Buchanan Book Prize of the Institute of British Foundrymen.

Mr. C. F. Lawson, Sheffield University. Buchanan Book Prize of the Institute of British Foundrymen.

National Certificates in Mechanical Engineering issued by the Board of Education and the Institution of Mechanical Engineers are endorsed by the President of this Institute in respect of those candidates who have been successful in special foundry subjects. Eleven National Certificates have been so endorsed during the last year, making a total of 155 since the commencement of the scheme.

The Degree Course in Foundry Metallurgy at the University of Sheffield has now been in operation for nearly three years, and the first students who have completed the Course are almost ready to enter industry. The number of students taking the Course is satisfactory, and the establishment of the Course has been fully justified.

The British Foundry School, which is in operation at the Central Technical College, Birmingham, and which was established mainly by the British Cast Iron Research Association, and its director, Mr. Pearce, is also completing its third year. This is a special, intensive course of one year's duration, intended for men who are already in the industry, and who wish to equip themselves for positions of greater responsibility. The careers subsequent to leaving of those students who have passed through the Course show that it is achieving the objects for which it was established.

MAJOR RICHARD MILES
(Junior Vice-President).

Annual Conference, Derby, 1937

The Thirty-fourth Annual Conference, which was held in Derby last June, was one of the most successful which has been arranged. A particularly noteworthy feature was the introduction of a session devoted entirely to non-ferrous subjects.

The annual general meeting was held on Tuesday, June 8, and was followed by a civic reception at the Bemrose School. The Wednesday and Thursday were mainly confined to technical sessions and works visits which were of a very high standard.

Mr. Joseph Hepworth, J.P., M.P., and Mr. W. B. Lake, J.P., were the elected Senior and Junior Vice-President respectively.

This Conference was attended by a large number of overseas members and visitors, representatives from Canada, Australia, Sweden, Germany, Persia, Singapore and Belgium being present.

The thanks of the Institute are especially due to the Worshipful the Mayor of Derby, Councillor Mrs. Petty, J.P., and to the Corporation of the Borough of Derby, for the valuable assistance they rendered in many directions. In addition to entertaining the members and ladies at a civic reception, special facilities were given by the Corporation in connection with the banquet and other functions. Those who were present at the Conference retain happy memories of the gracious manner in which the Mayor welcomed the delegates at the reception and the opening meeting, and the manner in which she co-operated in other meetings and functions.

The Council extends its thanks to the firms whose works were visited; to the authors of Papers; to the subscribers to the Conference Fund; and to all those who in any way assisted in making the Derby Conference so memorable an occasion. The work of the Branch officials, notably Mr. W. T. Evans, the President of the East Midlands Branch, Mr. H. Bunting, Chairman of the Conference Executive Committee, and Mr. B. Gale, Secretary of the Branch and Honorary Conference Secretary, is also appreciated by the Institute, for it is realised that the success of the Conference was in a large measure due to the enormous amount of work which these gentlemen carried out.

Edward Williams Lecture

Dr. C. H. Desch, F.R.S., Head of the Metallurgical Department of the National Physical Laboratory, delivered the Third Edward Williams Lecture on "Physical Factors in the Casting of Metals." It is regretted that at the Bradford Conference this year no Edward Williams Lecture will be given. An invitation was accepted by Sir Nigel Gresley, but unfortunately Sir Nigel's health has made it necessary for him to take an extended sea voyage, and he will not therefore be able to deliver the lecture. Arrangements are under way in preparation for the lecture to be given at the 1939 International Foundry Congress in London.

British Cast Iron Research Association

As was anticipated in the last report, the year 1936-37 created a new record. At the end of 1937, the President, the Rt. Hon. the Earl of Dudley, made an appeal to members and others in the industry for a sum of not less than £15,000 for the purpose of providing up-to-date accommodation and equipment for the Association's work, for which at least £30,000 is required. This appeal has the support and sympathy of the Department of Scientific and Industrial Research and all contributions made to date have been treated by the Department as grant-earning and by this their value has been doubled. The provision will meet a pronounced need for equipment for highly specialised work.

During the year steps have been taken to strengthen the connection between this Institute and the Association, and the B.C.I.R.A. has also carried out co-operative work with the Institute of Welding and the Institute of Vitreous Enamellers.

Council

Four meetings of the Council, and more than twenty meetings of special and standing Committees have been held during the year, such meetings having been held at Derby, Manchester, Bristol, Sheffield, London, and Leicester. There have been four meetings of the Technical Committee, a meeting of the Technical Council, and about forty meetings of various Sub-Committees of the Technical Committee.

Ten members of the Council are elected by ballot for a period of two years, five retiring each year. The five who so retire at the annual general meeting on June 14 are:—Mr. A. Campion, Mr. J. W. Gardom, Mr. B. Hird, Mr. F. K. Neath and Mr. J. M. Primrose. All these

gentlemen are eligible for re-election for a further period of two years, and offer themselves for re-election.

Hon. Treasurer.—Mr. W. B. Lake retired from the position of Hon. Treasurer, which he has held for four years, upon his election as Junior Vice-President, and was succeeded in the position of Hon. Treasurer by Mr. S. H. Russell, Past-President.

Mr. Lake's period of office as Treasurer has been a notable one; he has carried out several reforms in the finances of the Institute and has exercised the closest control over the general items of income and expenditure. The Council tenders to Mr. Lake its thanks for the work he has rendered in this capacity, and its congratulations upon his election to the position of Vice-President.

The thanks of the Council are also tendered to Mr. J. W. Gardom, the Convener of the Technical Committee, for his devoted work in the leadership of the various activities of this Committee and its Sub-Committees.

BRADFORD TECHNICAL COLLEGE, WHERE THE CONFERENCE WAS HELD.

Revision of Bye-Laws

Some eighteen months ago, the Board of Development made certain recommendations to the Council regarding qualifications for admission to the various classes of membership. These recommendations were accepted in principle by the Council, and were referred to an Organisation Committee to work out the details. This Committee has now completed its work, and has made recommendations for the necessary alterations to the Bye-laws which will be submitted for the approval of the members at the annual general meeting on June 14.

The main purpose of these revisions is that candidates for admission to the various classes of membership of the Institute shall give evidence of possessing certain technical qualifications or of having a minimum standard foundry experience; by this means it is hoped that membership will in itself be accepted as a definite proof of qualification. This is a principle which has been adopted with success by other technical institutions and the Council recommends these proposals to the members in the confident belief that they will improve the status of the individual member and that they will improve the status and standing of the Institute generally.

The Council has for some time been anxious to give greater service to members by more frequent publication of the "Proceedings," and by extending the work of the Technical Committee. It has not, however, been able to do so for financial reasons. Very careful consideration has been given to this matter, and the Council has now approved those proposed alterations to the Bye-laws which authorise certain increases in subscriptions, in the belief that the resultant increase in the Institute's income will enable these developments to be undertaken immediately.

A number of minor alterations in the Bye-laws have been made, the general purpose of which is to facilitate smoother and more efficient working.

Staff

Owing to the increased amount of work which has to be carried out by General Office, Mr. J. Bolton was appointed Assistant Secretary at the beginning of March.

Annual Conference

The Thirty-fifth Annual Conference will be held at Bradford, from June 14 to 17. Mr. Joseph Hepworth, J.P., M.P., the Senior Vice-President, will be installed President at the opening meeting on Wednesday, June 15.

C. W. BIGG,
President.

T. MAKEMSON,
Secretary.

Adoption of Report

The PRESIDENT moved the adoption of the Annual Report for the year ended April 30, 1938, and said that the reading of it would give nothing but feelings of satisfaction to all members.

MR. H. WINTERTON seconded the motion for the adoption of the Report.

The Report was adopted without discussion.

Accounts

MR. S. H. RUSSELL (Hon. Treasurer), presenting the balance sheet and the income and expenditure account for the year ended December 31, 1937, said that the financial position was satisfactory. The excess of income over expenditure, which was carried forward, amounted to £372, but he pointed out that, if one deducted the receipts from the South African Branch—£121—and sundry receipts, which were receipts other than subscriptions—£142—the income by way of subscriptions in Great Britain was only about £9 in excess of the total expenditure.

The gift of £500 made by the directors of Messrs. Qualcast, Limited, in 1937 would in future appear in the accounts as "The Technical Development Fund." It was hoped sincerely that there would be numerous and substantial additions to the Fund within the next two or three years. He moved the adoption of the accounts as printed.

MR. F. J. COOK (Past-President) seconded, and expressed congratulations and thanks to all who had contributed to the production of such satisfactory accounts.

The accounts were adopted without discussion.

Technical Committee's Report

MR. J. W. GARDOM (Convener of the Institute's Technical Committee) proposed the adoption of the reports of that Committee and its Sub-Committees. He commented that the work of the Committee and Sub-Committees had been difficult, in view of the many obstacles which had had to be overcome, but they were beginning to see daylight, and a few years hence the reports would be very much better than those published so far.

The resolution was seconded by MR. P. A. RUSSELL and carried unanimously.

SIXTH ANNUAL GENERAL REPORT OF THE TECHNICAL COMMITTEE

In fulfilment of the objects for which it was formed in 1931, the Technical Committee during the past year has been actively engaged in studying various technical developments in the foundry industry, and in collaborating with other scientific bodies which have been carrying out work on similar subjects.

In order to facilitate its work, the Committee is divided into eight Sub-Committees, which cover almost all phases of modern foundry practice. The reports of these Sub-Committees follow this report.

In addition to the work of the Sub-Committees, a considerable amount of work is carried out by the Technical Committee as a whole. Such activities include representation on national and international standardising and investigating bodies.

The Technical Committee's representatives, Dr. A. B. Everest, Mr. J. G. Pearce and the Secretary, attended the meeting of the International Committee on Testing Cast Iron, which was held in Paris in June, 1937. Contact with the American Foundrymen's Association has been maintained, notably through the Sands Sub-Committee, which has been studying various types of sand-testing apparatus. This Sub-Committee, together with the Steel Castings Sub-Committee, has also been co-operating with the Steel Castings Research Committee of the Iron and Steel Institute and the British Iron and Steel Federation. Amongst numerous other contacts which this Committee has maintained with kindred bodies elsewhere is that of the Cast Iron Sub-Committee with the International Committee on Testing Cast Iron. The subject in this case has been the classification of graphite.

Inquiry Bureau.—The inquiry bureau which is carried on by the Institute under the auspices of the Technical Committee has continued to provide for members a useful service which has been much appreciated.

Nomenclature.—From time to time the Technical Committee has been able to assist members in the definition of certain terms. During the past year this service has also been made use of by foreign inquirers. It is hoped that in time a comprehensive list of definitions will be made available to members of the Institute.

The Technical Committee wishes to express the thanks of the Institute to those members who have so willingly given their time both to attending meetings and to furthering the work

of the Committee and its Sub-Committees by private research. The thanks of the Institute are also extended to those firms which so kindly provide facilities for members of their staffs to attend meetings; to those firms which have so readily carried out research and tests in connection with the work of the Technical Committee, and to those firms which have co-operated with the Committee by answering the questionnaires which have been circularised.

J. W. GARDOM,
Convener, Technical Committee.

REPORTS OF SUB-COMMITTEES

Sub-Committee on Cast Iron

During the past year the Cast Iron Sub-Committee has continued to co-operate with the British Standards Institution in handling specifications, directly or indirectly concerning cast iron. Early in 1938, the new Specification, No. 786, for High-Duty Cast Iron was published, the figures finally adopted being based largely on the data submitted by this Sub-Committee. At the same time the revision of Specification No. 321/1928, for Grey Cast Iron, was issued. The Sub-Committee also considered the final draft of the proposed new specification for cast-iron gears and made recommendations which have now been adopted by the British Standards Institution. The Sub-Committee has now under consideration a proposed specification for cast-iron surface plates and marking-off tables, which includes recommended compositions.

It has been agreed that the Sub-Committee should publish a Paper discussing the Sub-Committee's part in the preparation of the new specification for high-duty cast iron, and include in it references to physical and mechanical properties of grey cast iron. This Paper is now in hand and will be available to Branches for the 1938-39 session.

Further consideration has been given during the year to the possibility of issuing recommended methods of running and risering grey iron castings. This work involves many difficulties and at the present time a sheet of drawings of simple types of castings is being circulated to selected foundries who are asked to indicate the methods of running and risering they would recommend. This work should indicate how far it will be possible to proceed, with a view to drawing up final recommendations for issue to industry.

In co-operation with the International Committee for Testing Cast Iron, various suggested systems of classifying graphite form and size in grey cast iron have been under review. This work is still in hand and the Sub-Committee will co-operate with Professor Portevin in France and the Committee recently set up for the purpose of studying this question by the American Foundrymen's Association.

P. A. RUSSELL,
Convener.

Sub-Committee on Costing

Since the presentation of the Sub-Committee's report (Recommendations concerning the Establishment of Costs in a Grey Iron Foundry) at the Annual Conference at Derby, in June, 1937, no important developments have occurred in the Sub-Committee's work. It had been decided to await the reactions of the foundry industry to the Report.

Two interesting events have occurred in the meantime. Firstly, the Report was presented last January before the Birmingham Branch of the Institute of Cost and Works Accountants, at the request of that organisation. The attendance was quite large and considerable interest was shown, as proved by the discussion that followed. It is interesting to note, however, that the Report was criticised, particularly as regards the recommendation that overheads should be allocated on a labour cost basis.

The second event, of material importance to the work of the Sub-Committee, is that the Report has been recommended to its members by the Midland Iron Founders' Association. Furthermore, in the past twelve months requests have been received for copies of the Report from a number of individuals and important foundries.

It is now the hope of the members of the Sub-Committee that in the near future those foundries that have endeavoured to adopt the system, or be guided by it, will give the results of their actual experience, thereby enabling the Sub-Committee to revise the system in the light of such actual experience.

V. DELPORT,
Convener.

Sub-Committee on Malleable Cast Iron

During the past twelve months, the Malleable Cast Iron Sub-Committee has been largely engaged in surveying the investigations recently brought to a close, and in planning out the procedure regarding the revision of the B.S.I. specifications.

The report on dimensional tolerances has been finalised, but the Sub-Committee feels that the time is not yet ripe for the insertion of a tolerance clause in specifications. The "Varied-Size Bar Investigation" has also been completed. In the case of whiteheart, it being found impossible to correlate tests on the standard bar with the tests obtained on the other sizes of bar. The work on this investigation now comes within the scope of the present work on specifications.

The question of the revision of the B.S.I. Specification for Malleable Cast Iron has been carefully considered by the Sub-Committee, recommendations having been finalised regarding the clauses covering machinability, and provision of test-bars. Regarding the tensile requirements, it has been decided to undertake further investigations for the whiteheart series incorporating the smaller diameter test-bar, and also the bar with a shorter gauge length.

A questionnaire has also been prepared on the current B.S.I. Specifications. This questionnaire is now in circulation, and immediately replies come to hand, this work can proceed.

A. E. PEACE,
Convener.

Sub-Committee on Melting Furnaces

As stated in the Sub-Committee's Report for 1936-37, this Sub-Committee is engaged in the preparation of a report on furnaces used in the melting of grey cast iron in order to provide data on modern melting practice. During the year a considerable amount of data has been examined and correlated in connection with various sections of the report, and further sections have been completed.

A GROUP OF CONFERENCE DELEGATES ON THE STEPS OF BRADFORD TECHNICAL COLLEGE.

It is hoped to incorporate a section giving comparative melting costs of the various types of furnace. This work has involved a study of the average sizes of the various furnaces and average throughputs and mixtures for each type as well as many other factors. Considerable progress has been made, and the report is now nearing completion.

L. W. BOLTON,
Convener.

Sub-Committee on Non-Ferrous Castings

The Sub-Committee has given final consideration to the criticisms raised in the discussion on its Report: "Recommendation for Two Leaded Gunmetals." It was decided that no modification was called for in the recommendations as a consequence of the discussions held by the various Branches of the Institute, and the Secretary was therefore asked to approach the British Standards Institution with the request that they consider drawing up two new specifications for leaded gunmetals. The British Standards Institution has intimated its willingness to discuss this suggestion, and a memorandum covering the Sub-Committee's recommendations has been presented to them.

Further consideration has been given to the work on leaded phosphor-bronzes, and a number of further tests is being conducted in various foundries. In addition, an investigation has been undertaken on the effect of additions of small amounts of nickel to leaded phosphor-bronzes. Three compositions of leaded phosphor-

bronzes suitable for bearings have been decided upon and are now under investigation, and it is hoped, in due course, to be able to submit recommendations for standard specifications covering these materials.

L. B. HUNT,
Convener.

Sub-Committee on Sands

Considerable progress has been made during the past year with work on sand testing. In particular the Sub-Committee has completed its recommendations for the routine testing of dry sands and loam, and approved sieve sizes for grading of foundry sands.

A draft report on "Moulding Sands used in British Foundries" has been completed and circulated to all members of the Technical Committee. This is based on information obtained from a questionnaire circulated to foundries in all parts of the country. Work now proceeding includes the consideration of core sand testing, and in particular the investigation of drying ovens. A new undertaking of the Committee is its work on casting defects.

Further co-operation between this Committee and the Moulding Materials Sub-Committee of the Iron and Steel Institute, during the past session, through the good offices of Mr. T. R. Walker, has resulted in agreement on certain common standards to be used in testing or investigatory work. Members of the Sub-Committee have also been active in making comparison between different types of sand testing apparatus, and in general, satisfactory agreement has been found between the more recent types of British and American equipment. We regret to report the resignation this year of Mr. A. Campion, one of the original members of the Committee, and welcome as a new member, Mr. G. F. Thonger.

J. J. SHEEHAN,
Convener.

Sub-Committee on Steel Castings

In order to complete and finalise the data on the heat-treatment of steel castings (which has been gradually collected since the formation of the Sub-Committee) a questionnaire has, by courtesy of the General Steel Castings Association, been circulated to all steel founders. There has been a generous response to this, and the Sub-Committee is now in possession of very complete and detailed data upon the practice of steel founders in this country for the treatment of all classes of carbon steel castings. The treatments employed show wide differences in the methods used to attain similar results. Some of the methods appear to be wasteful and show excessive expenditure of both time and fuel, with attendant difficulties in the way of scale formation and wear of refractories. It is hoped that after proper tabulation and classification it will be possible to prepare a report giving recommendations for simplified and standardised practices which may be of value to the industry.

The experimental valve castings made for test and destruction have now been sectioned, and although all the castings withstood the highest test pressures, a number of interesting defects have been revealed. The drawings showing the methods employed in manufacture, sulphur prints and macro etchings showing the internal structure of the castings, together with the test results are now being circulated for study by members of the Sub-Committee. Although the result of this research is largely negative, it is felt that the present results will form a useful starting point for future research either by this Sub-Committee or any other interested body to whom the results could be made available. The Sub-Committee wishes to express its appreciation of the help given by Mr. F. Hudson and Glenfield & Kennedy, Limited, in testing and sectioning the castings.

C. H. KAIN,
Convener.

Sub-Committee on Refractories

The Sub-Committee has met on several occasions during the past year, and has been engaged in the consideration of cupola ganister with a view to the preparation of a draft specification for a standard quality ganister. The members of the Sub-Committee have made numerous practical tests on the properties and behaviour of samples of commercial cupola ganister as delivered for foundry use, and a good deal of progress has been made. The Sub-Committee is, however, not prepared yet to put its recommendations forward for consideration by the Technical Committee. Investigations are still being carried on, and a report will be submitted as early as possible.

W. J. REES,
Convener.

Medals and Diplomas

The PRESIDENT announced that the Oliver Stubbs Medal for 1938 had been awarded to Mr. S. E. Dawson, of the East Midlands Branch;

MR. S. E. DAWSON
(*Oliver Stubbs Medallist*).

and that the E. J. Fox Gold Medal had been awarded to Mr. J. E. Hurst.

The GENERAL SECRETARY announced that the Council had awarded Diplomas to the following:—

Mr. A. Tipper for a Paper on "Synthetic Sand *versus* Natural Sand."

Mr. A. Phillips for a Paper on "Some Points on Non-Ferrous Foundry Practice."

Mr. Paul Fassotte (Belgium) for a Paper on "Trends of Continental Foundry Practice."

Mr. B. MacDougall for a Paper on "High-Duty Iron; Some Experiments with a Rocking Arc Electric Furnace."

Mr. J. Cameron, Jun., for a Paper on "The Fettling Shop."

The GENERAL SECRETARY added that certain recommendations had been made which the Council had not yet had an opportunity to examine fully, and further Diplomas might be awarded at the October meeting of the Council.

Election of Mr. E. J. Fox as Honorary Member

The PRESIDENT proposed that Mr. E. J. Fox (managing director of the Stanton Ironworks Company, Limited) be elected an Honorary Member of the Institute. In doing so, he said that nobody was more jealous than he in regard to election to honorary membership of the Institute; it should be a recognition only of very signal services to the industry or to the Institute, or to both, but he had no hesitation whatever in proposing the election of Mr. Fox, for all were well aware of his great work for the industry and for the Institute.

MR. H. BUNTING seconded, and emphasised the value and importance of Mr. Fox's great work in connection with education and other matters worthy of consideration; the Institute was right in recognising by honorary membership his great qualities and his great work on behalf of the Institute.

The proposal was carried with acclamation.

Election of President

The PRESIDENT, proposing the election of Mr. J. Hepworth, J.P., M.P., of Bradford, as President for the year 1938-39, said that a lifetime of experience in the industry and a very great deal of public service, which had culminated during the past few years in election as a Member of the mother of Parliaments, was surely sufficient to fit a man to become a President of the Institute. Possibly the oppositions in the Council meetings were more spontaneous and the majorities not quite so dependable as in the more exalted sphere of Parliament, but he had not the least doubt that Mr. Hepworth would soon adapt himself to the new conditions. It was a source of the greatest possible pleasure to propose his election.

MR. A. S. WORCESTER (President of the West Riding Branch) seconded, and said that the election would be an honour not only to Mr. Hepworth personally, but also to the West Riding Branch, which had not previously had the pleasure of organising a Conference in its district. He was certain that Mr. Hepworth would add lustre to the Presidential office. Although he was a very busy man, who had to do a great deal of work outside the industry, the Branch had profited greatly by his services, and no doubt he would be able to render good service nationally as well as locally.

Mr. Worcester also took the opportunity to welcome, on behalf of the West Riding Branch, all who were attending the Conference.

The resolution was carried with acclamation.

MR. HEPWORTH, in a brief response, expressed his appreciation of the honour conferred upon him, and said he would do his best to emulate the example of his predecessor, Mr. Bigg, though that was going to be a very difficult task.

Proposing a hearty vote of thanks to Mr. Bigg, he said it had been a pleasure to work with him during his Presidency, and if he himself could carry on his work as President in the coming year as well as Mr. Bigg had done, he would have no regrets. The Institute was deeply indebted to him for the splendid way in which he had carried out his Presidential duties.

The vote of thanks was carried with enthusiasm.

MR. BIGG, responding, said his year of office had been a very happy one. It had meant a certain sacrifice of time, but he had been more than repaid. He repeated a remark he had made earlier, that he derived more from the Institute than he could possibly put into it. He took the opportunity also to pay tribute to his colleagues on the General Council, and said that, although he believed the matters discussed during the past year had been as contentious as, and possibly more contentious than, in any year in the past, they had always reached their conclusions with a harmony which had made the office of President a very pleasant one. He also expressed his personal appreciation of the help he had received from Mr. Makemson, the General Secretary, and from all others with whom he had been associated.

Election of Vice-Presidents

MR. V. C. FAULKNER proposed the election of Mr. W. B. Lake, J.P. (Junior Vice-President), as Senior Vice-President for the ensuing year. He recalled Mr. Lake's work as a pioneer in the foundry industry and in other activities, and said that, when Mr. Lake became President of

the Institute in due course, he would be the first steel foundry owner to hold that office. Therefore, in electing him, the Institute would be repairing an omission of long standing. For a full decade Mr. Lake had rendered wonderfully regular and consistent service.

Mr. Faulkner recalled that in 1926, which was his own year of Presidency, and in 1929, during the Presidency of Mr. Wesley Lambert, when Conferences had been held in London, Mr. Lake had rendered invaluable help, and the experience he had gained on those occasions would be valuable to him in connection with the great International Conference to be held in London in 1939, when Mr. Lake would succeed to the Presidency.

MR. J. HEPWORTH (President-Elect), seconding, said he looked forward to the assistance of Mr. Lake during the coming year, and he was confident, with his knowledge of Mr. Lake, that they would work together splendidly during the coming year.

The resolution was carried with enthusiasm.

MR. W. B. LAKE, J.P., in a brief response, said he had the interests of the Institute very closely at heart, and would do his utmost to deserve the confidence reposed in him.

MR. J. E. HURST (Past-President) proposed the election of Major R. Miles as Junior Vice-President. He was glad to recall that for a number of years he had worked as a colleague in Messrs. Newton, Chambers with Major Miles, who was an early member of the Institute and was definitely a foundryman. He was a son of the late Mr. Miles (who was general manager of Newton, Chambers Ironworks and Foundries), and had since become managing director of Head, Wrightson & Company, Limited, of Thornaby, which company owned a very substantial foundry. The reason for using his military title was to distinguish between him and his brother, who had attained the rank of Captain. Major Miles held the Degree of Master of Engineering in the Faculty of Engineering at Sheffield University. He had been always a stalwart supporter of the activities of the Institute, and on numberless occasions had been glad to help the Institute and the Sheffield Branch in particular. From personal knowledge it was a pleasure to recommend him as a worthy occupant of the office of Junior Vice-President, and in due course he would maintain the traditions of the Institute as its President.

MR. J. K. SMITHSON (Middlesbrough), seconding the election of Major Miles, said that the members of the Middlesbrough Branch were unanimous in their support. Major Miles, in addition to his own work for the Institute, always gave every encouragement to his staff to help by reading technical Papers and in other ways. They hoped and expected that in due course he would occupy the Presidential Chair with distinction and success.

Major Miles was unanimously elected.

Auditors

On the motion of Mr. A. Harley (Past-President), seconded by Mr. C. H. Kain, the meeting re-elected J. & A. W. Sully & Company (chartered accountants) as auditors to the Institute.

Vote of Thanks to Officers and Council

MR. F. J. COOK (Past-President), proposing a vote of thanks to the officers and Council, said he did not think the Institute had ever been served better than it was being served at present, and had been served during the past year, by its officers and Council, and the meeting would wish to join in tendering to them a very hearty vote of thanks.

The vote of thanks was carried with acclamation, and Mr. Bigg briefly responded.

Elections to Council

It was announced that, as the result of the ballot, the following were elected to fill the five vacancies on the Council:—Mr. H. Bunting (Derby); Dr. A. B. Everest (London); Mr. J. W. Gardom (Birmingham); Mr. B. Hird (Cardiff); and Mr. F. K. Neath, B.Sc. (Leeds).

Revision of Bye-Laws

MR. S. H. RUSSELL put forward the proposed Bye-Laws of the Institute, as revised by the Organisation Committee which had worked out the details, following the recommendations of the Board of Development concerning qualifications for admission to the various classes of membership, which recommendations were accepted in principle by the Council.

A complete print of the proposed new Bye-Laws was in the hands of members, and Mr. Russell proposed the following resolution:—

"That the Bye-Laws so altered and added to and as contained in the print laid before the Meeting be and the same are hereby adopted as the Bye-Laws of the Institute in lieu of the present Bye-Laws, such present Bye-Laws to cease to have effect and the Bye-Laws so adopted to come into force and effect when and so soon as the approval of the Privy Council to the Bye-Laws so adopted and the certificate of such approval under the hand of the Clerk of the Privy Council have been obtained."

MR. J. E. HURST
(*E. J. Fox Medallist*).

Commenting on the new Bye-Laws and the principal changes, he drew attention to the part of Bye-Law 3 dealing with Associates, which provided that an operative engaged in the foundry industry should be entitled to remain in membership as an Associate irrespective of age, and that no other person unless elected an Associate prior to July 1, 1938, could retain membership as an Associate after attaining the age of 28 years.

Bye-Law 4 entitled Honorary Members, Members and Associate Members to use after their names the initials appropriate to their grades of membership.

In view of suggestions made from time to time that, if the revised Bye-Laws were adopted, some of those at present in membership would have to sit for an examination, he emphasised that, under Bye-Law 5, persons in membership at the date the Bye-Laws became operative could continue in the class of membership they held at that date, irrespective of their qualifications.

Another Bye-Law to which he drew attention was No. 9, providing that annual subscriptions should be £3 3s. for a Member, £1 11s. 6d. for an Associate Member, 10s. for an Associate of 21 years of age or over, and 5s. for an Associate under 21 years of age; that a Member or Associate Member who attained the age of 65 years, and had been a Member of an Associate Member for at least 25 years, and whose subscription was not in arrear, should be entitled to remain in Membership or Associate Membership without the payment of any further subscription; and that the Institute should have the right to impose entrance fees at an annual general meeting in the future—but, he added, that there was no suggestion at the moment to propose the imposition of entrance fees.

Bye-Law 16 was inserted, on the advice of the Institute's solicitor, to clarify the position regarding voting by a show of hands or by ballot at the meetings of the Council.

Bye-Law 17 gave power to elect as additional members of the Council representatives of kindred institutions and/or research associations not exceeding five in number.

Bye-Law 18 was a modification of the existing Bye-Law regarding the nomination of Vice-Presidents. It was sometimes inconvenient, he said, to invite each Branch each year to nominate a Vice-President of the Institute. Therefore, the revised Bye-Laws provided that a committee should meet and should invite a Branch to make a nomination. He emphasised that under the existing Bye-Laws it was embarrassing to invite each Branch to nominate a Vice-President, when it was not the intention to hold a convention in the district of any particular Branch during the next following two or three years.

In Bye-Law 23, the Hon. Treasurer was added to the Executive Committee.

Bye-Law 27 provided that 14 days' notice must be given of each annual general meeting; and Bye-Law 29 provided that 14 days' notice should be given of a general meeting.

Bye-Law 43 was inserted on the advice of the Institute's solicitor, who had devoted a considerable amount of time and care to the consideration of the Bye-Laws. He had suggested the Bye-Law governing the issue of notices of meetings, etc.

On Bye-Law 44, dealing with arbitration, MR. RUSSELL proposed a slight amendment, to delete the words, "and disposed of under the provisions contained in these Bye-Laws," and to substitute "By agreement between the parties to the question, dispute or difference." The amendment also added the following words to Bye-Law 44:—

POSSIBLE AMENDMENT OF BYE-LAW 44

". . . can agree upon one and otherwise to two arbitrators one to be appointed by each party to the question, dispute or difference (whether such party shall consist of one or more than one person) and in either case in accordance with the provisions of the Arbitration Act, 1889, or any statutory modification or re-enactment thereof for the time being in force. Neither party to a question dispute or difference shall require or apply to the court to direct the arbitrator or arbitrators to state a case on any question of law arising in the course of the reference or arbitration and all questions of law so arising shall be determined by the arbitrator or arbitrators, any provisions in the Arbitration Act, 1889, to the contrary notwithstanding."

MR. RUSSELL added that the Bye-Laws had been discussed in General Council and in the Branch Councils over a period of 18 months. Whilst he would not suggest that there was unanimity of opinion, there was a very substantial majority in favour of the Bye-Laws as proposed, and he was convinced that they would prove to be to the ultimate good of the Institute.

MR. H. WINTERTON (Past-President) seconded the resolution for the adoption of the revised Bye-laws.

MR. H. BUNTING criticised the provision, in Bye-law 15, whereby the Council was to include 10 elected members, because it seemed to him most ridiculous that the members elected by the whole membership of the Institute should form so small a minority on the Council. He suggested at least half the Council should be members elected by ballot instead of, as at present, there being 10 members so elected out of a Council numbering about 60, including the Past-Presidents. He did not suggest increasing the size of the Council, but rather a reduction of the representation of the Branches.

MR. BIGG pointed out that the question was merely one of method. In addition to the 10 elected members of the Council there were Branch representatives on the Council, and those representatives were elected by the Branches. The more important consideration was that if a larger number of the members of the Council were elected by ballot by the whole membership of the Institute, possibly certain Branches would not be properly represented on the Council.

MR. BUNTING, when asked if he wished to move a resolution, moved formally that the number of elected members of the Council should constitute half the total Council membership.

MR. A. HARLEY (Past-President) said he had a certain amount of sympathy with the proposition. He complained that when the whole membership of the Institute elected a member of Council by ballot, that member remained on the Council for only two years, which was too short a period. It would be much better to have 15 elected members, of whom five should retire each year. Thus, each member would be elected for three years.

MR. BUNTING said that that was his view, and he amended his proposition to that effect, *i.e.*, that there should be 15 elected members of Council, of which five should retire each year.

MR. HARLEY seconded.

MR. T. HENRY TURNER opposed the motion. He pointed out that the Institute of British Foundrymen had a very much more democratic basis than other bodies, and that the representation of the Branches was exceptionally good. The representation of the ordinary members went right through to the main Council. If the proposal made by Mr. Bunting were adopted, either the Council would become excessively large (by adding another five members) or the members of the Institute generally would be asked to vote for nominees from various Branches of whom they might have no knowledge at all. He urged that the existing method was very much better than the method proposed.

MR. F. J. COOK (Past-President) said that if Mr. Turner wished to move an amendment to the effect that the system should remain as at present, he would be pleased to second it. (Such an amendment would constitute a direct negative, however, and could not be accepted.)

The resolution proposed by Mr. Bunting and seconded by Mr. Harley was lost by a large majority.

MR. R. BALLANTINE proposed, as an amendment to the resolution for the adoption of the Bye-Laws, that their adoption be delayed for a year. As a member of the Scottish Branch, he said that that Branch was in a peculiar position and had difficulty in securing new members. The endeavour should be made to secure a greater membership among the younger men in the industry; the improvement of the status of the Institute was a secondary consideration.

MR. E. LONGDEN seconded the amendment. In view of the position of the Scottish Branch, he felt that a little delay would be worth while.

MR. A. MARSHALL (Scottish Branch) supported the amendment, and urged that an increase of subscriptions would constitute a barrier against men who were working on the foundry floor becoming members of the Institute. If some of his words were a little blunt, he said, that was due only to his enthusiasm for the Institute; and he suggested that if the General Council had thought there would be no kick against the new Bye-Laws, probably it would have increased the fees still further.

MR. BIGG said that that remark might be blunt, but it was not justified.

MR. D. SHARPE (a Past-President of the Scottish Branch) supported the attitude of the previous speakers in support of the amendment, and said that in Scotland it had been a struggle to introduce practical foundrymen as members of the Institute. It was also a struggle all over the country to persuade some of those men to give Papers and make comments on shop practice. Nevertheless, the Scottish Branch had succeeded in that to a certain extent. If subscriptions were increased, it would be more difficult to attract some of the practical men into the Institute, one of the primary objects of which was education, and, therefore, he urged that the adoption of the Bye-Laws be delayed for a year

THE LORD MAYOR OF BRADFORD.
(Alderman Henry Hudson, J.P.)

in order that they might be reconsidered from the point of view of the practical man in the shop.

MR. F. HUDSON (Past-President of the Scottish Branch) was also in sympathy with the practical men in Scotland. He recalled that during his year of office the membership of the Branch had reached the 300 mark as the result of the efforts made there, and he was afraid that if the revised Bye-Laws were adopted now, the tendency would be in the opposite direction.

MR. H. BUNTING (Derby) asked what advantage was to be gained by delaying the adoption of the revised Bye-Laws for a year.

MR. R. BALLANTINE (President of the Scottish Branch) said he was endeavouring to increase the membership of the Scottish Branch beyond 300, and he was afraid that if the Bye-Laws were adopted, the Branch would lose about 120 members. He pointed out that the Branch covered a very wide area, and the men had to pay their fares over considerable distances in order to attend lectures, so that he did not wish to see subscriptions increased.

MR. T. HENRY TURNER suggested that the Council might with advantage explain some of the reasons for the revision of the Bye-Laws. He pointed out that the accounts for 1937 had balanced, and said that if more money were required, it must be required for some purpose.

Object of the Proposed Changes

MR. S. H. RUSSELL said that the suggestion to increase income had arisen originally because it was felt desirable to render improved service to the members. It was felt that the "Proceedings" as at present issued were rather late and, having already appeared in the trade Press, were of limited value to foundrymen. It was hoped that, with increased resources, it would be possible to publish the "Proceedings" more frequently than in the past, though perhaps not quarterly to begin with. It was also intended that certain findings of the Technical Committee should be published confidentially for the information of members only. The work of the Technical Committee and its Sub-Committees was still in its infancy, but it was valuable work and could not be carried on without money; the Institute at present had not the funds with which to foster the necessary investigation and research. The work done so far had been carried on voluntarily by a limited number of well-disposed persons and firms, but the Institute could not for ever draw on those sources. Two years ago the Council had passed a resolution agreeing in principle to an increase of subscriptions in order that the work should be carried on. It would be dangerous to draw the conclusion that there was a very substantial surplus of money each year in the Institute; the actual amount of the subscriptions from members in Great Britain exceeded expenditure by a very few pounds, but a substantial sum could be spent very quickly on research or investigation with results of which the members would receive full benefit.

He could appreciate how the draft new Bye-Laws differed from the point of view of the Scottish members. It was definitely in the minds of the majority of those responsible for those revised Bye-Laws that a man should be something more than an ordinary moulder before he became an Associate Member of the Institute. That might be right or it might be wrong; but the Bye-Laws had been specifically drawn up by men with that thought at the back of their minds, and, so far as he knew, the whole Council had been quite fully aware of that. It had been emphasised by the critics that the ordinary moulder or journeyman would have difficulty in paying the increased subscription as an Associate Member; and he fully agreed. But, rightly or wrongly, the Bye-Laws were not drawn up particularly to cater for that man, except as an Associate. It was felt that a Member should be something more than a skilled operative, and rules were inserted which called for some educational qualification, or some phase of responsibility (perhaps only limited responsibility) in addition to practical knowledge, so that when a man was entitled to call himself a Member or Associate Member, it would be appreciated that he had rather more qualifications than the ordinary journeyman. It appeared that that was not clearly understood by all the members. The type of person who would pay a subscription of £1 11s. 6d. would receive back by way of service three or four or more times that value. He fully agreed that for the average journeyman working on the floor the subscription was more than he could afford; but the new Bye-Laws were not drafted to cater for that type of man except as an Associate. If such a man were already an Associate Member, he could remain an Associate Member by paying the extra money, and it would be to his advantage. But if he resigned, and wished to become a member again at a later date, he could only join as an Associate. That was the point about which the members had to make up their minds.

MR. BIGG said that the meeting could not pretend to be able to discuss the matter fully in the time available or to discuss it to the extent that seemed to be demanded; therefore, he suggested that the meeting might be adjourned until about October next, so that everybody would have the opportunity to express their views.

With regard to the suggestion made earlier that, if there had not been a kick against the proposed new Bye-Laws, the Council would have increased the subscription much further than was

proposed, he said that it was entirely unjustified. He was very proud of his colleagues who had been concerned with the discussion of the proposed Bye-Laws, and they had put in a lot of hard work.

MR. D. SHARPE, seconding the proposal to adjourn the meeting, said he welcomed Mr. Russell's very frank admission that the matter required further consideration.

MR. S. H. RUSSELL said he had expressed his own personal point of view, and he was not prepared to accept Mr. Sharpe's interpretation of his remarks.

Adjournment of Meeting Supported

MR. BEN HIRD (Cardiff) said that he supported the proposed adjournment. Mr. Russell had hit the nail on the head. The members must get into their minds that a definite change was proposed, which applied to all Branches as it did to the Scottish Branch. Something more than a mere change in respect of £ s. d. was being proposed, and the members must face up to it. He favoured very much the proposal to hold a meeting to discuss the matter thoroughly.

MR. J. W. GARDOM (Birmingham) emphasised that the proposed new Bye-Laws had been under consideration for nearly two years and everybody had had an opportunity of discussing them, for they had been put to the Branches and there had been special Council meetings for their discussion. He suggested that there was really nothing in the argument about the subscription to be paid by the workman, who could become an Associate for a subscription of 10s. a year, and who would benefit by the extra money subscribed by members in other grades. One of the things it was desired to do was to be able to pay the expenses of good lecturers who would attend the Branch Meetings and would benefit workmen as much as anybody else. The Institute wanted to bring the men forward. He urged that the meeting should vote on the proposition to adopt the new Bye-Laws.

MR. BIGG said he would be sorry to feel that, under his chairmanship, the opportunity was not afforded to ventilate the matter to the fullest extent and to consider every phase. Each individual considered that his own view was the right one, but the time available was not sufficient for a full discussion, and he did not wish to hurry it. The meeting could be adjourned until a later date for full discussion of the matter.

THE BRADFORD CONFERENCE COMMITTEE

MR. H. FORREST.
(Chairman of the Committee).

MR. A. S. WORCESTER
(West Riding Branch-President).

MR. W. G. THORNTON
(Hon. Conference Treasurer).

MR. S. W. WISE
(Hon. Conference Secretary).

Implications of Adjournment

A MEMBER pointed out that no alteration to the Bye-Laws could be made except at an Annual General Meeting. It seemed, therefore, that unless the present Annual General Meeting were adjourned, the matter could not be carried through until next year.

MR. BARRINGTON HOOPER, C.B.E., said it was important to make sure whether there was to be an adjournment of the Annual General Meeting or whether a special meeting was to be held.

MR. A. HARLEY suggested that the way out of the difficulty was to call an Extraordinary General Meeting for the specific purpose of discussing the new Bye-Laws; at that meeting the members could make up their minds as to the proposals which should be submitted to the next Annual General Meeting.

MR. BEN HIRD said that the next Annual General Meeting would be held in London, and it would be an appropriate occasion to take a step such as was contemplated

A MEMBER supported Mr. Harley's suggestion to call an Extraordinary General Meeting and to come to decisions concerning the Bye-Laws, so that those decisions could be adopted at the next Annual General Meeting.

MR. H. WINTERTON said that presumably the present Annual General Meeting would be concluded, and the business of dealing with the Bye-Laws would be taken out of the business of that meeting and would be the subject of the Extraordinary General Meeting to be held in October.

MR. W. B. LAKE suggested that the proper course was to adjourn the Annual General Meeting until October; otherwise a whole year would be lost.

MR. WINTERTON made the point that the business of an Annual General Meeting must be concluded if any of the decisions arrived at by that meeting were to have effect. If the business of the meeting were not definitely concluded, then the elections of the new officers, etc., could not stand.

A MEMBER, having ascertained from the General Secretary that it might take several months to secure the approval of the Privy Council after the revised Bye-Laws were submitted, pointed out that the new Bye-Laws could not in any case become operative for at least another twelve months. If consideration of the Bye-Laws were adjourned for a year, it was probable that they would not become operative for another two years from the present date.

MR. LAKE proposed an amendment that the Annual General Meeting be adjourned until a date in October.

MR. STOBIE (Past-President) seconded that amendment, and said there was nothing to prevent giving effect to the resolutions already passed at the meeting, and adjourning the consideration of the Bye-Laws.

MR. HIRD asked definitely whether the adjournment of the Annual General Meeting would mean that the election of officers would not stand.

MR. BIGG said it did not.

The amendment to adjourn the meeting until October was then put to the meeting and carried.

CIVIC RECEPTION

On Tuesday evening the members and their ladies were received at the Cartwright Memorial Hall, Bradford's Art Gallery, by the Lord Mayor and Lady Mayoress (Alderman Henry Hudson and Mrs. Hudson). The Hall, situated in a wide park, was a very fitting setting for such a function. There was much of the artistic to interest the guests, who numbered about 300, and there were facilities for dancing, and a very fine concert arranged for the entertainment of the visitors. The catering also left nothing to be desired.

THE CARTWRIGHT MEMORIAL HALL, LISTER PARK, WHERE THE CIVIC RECEPTION WAS GIVEN.

OPENING OF CONFERENCE

The Lord Mayor (Alderman Henry Hudson, J.P.) and his colleagues were present at the Bradford Technical College at a comparatively early hour on Wednesday morning, June 15, to bid the members and visitors welcome to the city and to open the Conference. With him on the flower-decked platform in the Great Hall were Alderman J. W. Longley (Chairman of the Bradford Technical Education Sub-Committee), Alderman S. Horsfall (Chairman of the Bradford Parks Committee), Mr. H. Richardson (Principal of the Bradford Technical College), Mr. C. W. Bigg (Retiring President) and Mrs. Bigg, Mr. J. Hepworth, J.P., M.P. (President-Elect) and Mrs. Hepworth, Mr. W. B. Lake, J.P., and Major R. Miles (Vice-Presidents), Mr. E. J. Fox (managing director of the Stanton Ironworks Company, Limited, and an Honorary Member of the Institute), Messrs. S. H. Russell, F. J. Cook, V. C. Faulkner, A. Harley, V. Stobie, Roy Stubbs, J. E. Hurst and H. Winterton (Past-Presidents of the Institute), Mr. A. S. Worcester (President of the West Riding of Yorkshire Branch), Mr. H. Forrest (Chairman of the Conference Committee), Mr. W. G. Thornton (Hon. Conference Treasurer), Mr. S. W. Wise (Hon. Conference Secretary) and Mr. T. Makemson (General Secretary of the Institute).

The LORD MAYOR, who was introduced by Mr. Bigg, extended a hearty welcome to all attending the conference, and expressed the hope that they would derive pleasure and instruction from it. He talked of his pride in Bradford and its surroundings, of the improvement of the amenities of life in that and other cities, and urged all to help to effect such improvement in their own cities, which would make our country a far better one to live in than it had been in the past.

Presentation of Medals

The Lord Mayor presented to Mr. S. E. Dawson (East Midlands Branch) the Oliver Stubbs Medal, which is awarded for conspicuous services to the Institute and to the industry.

MR. BIGG said that the Council had had to deliberate very carefully with regard to the award of the Medal for 1938, for competition to render service was keen, but, ultimately the decision to award it to Mr. Dawson was unanimous.

MR. DAWSON, on receiving the Medal, expressed his keen appreciation of the honour, which was coveted by every member of the Institute; and he had special pride in receiving the Medal because he had known Mr. Oliver Stubbs personally. He hoped to maintain the tradition surrounding the Medal, which had been endowed by previous recipients.

MR. E. J. FOX (managing director of the Stanton Ironworks Company, Limited), the donor of the E. J. Fox Gold Medal, which is awarded for outstanding contributions to the progress of the foundry industry, with particular reference to foundry metallurgy, presented the Medal to Mr. J. E. Hurst, a Past-President of the Institute. Perhaps, he said, he had been asked to present it, not only because he was the donor, but also because he represented ironfounding interests of this country, which in magnitude were far in excess of the ironfounding interests of any other country of the world. Mr. Hurst had devoted practically his whole lifetime to the analytical and metallurgical side of iron founding, and those who were deeply concerned with the industry owed him a tremendous debt of gratitude for his good work, whilst at the same time they looked forward to further good work by him in the future. It was unnecessary in such a gathering as the annual conference of the Institute to recite Mr. Hurst's qualifications, as one could do at very considerable length; but it was a pleasure and pride to present the Medal to him, and particularly gratifying to welcome him back after his recent illness. (Applause.)

MR. HURST, in response, expressed his great pride in the award of the Medal to him, and in the fact that it had been presented by the donor personally. During the last 25 years he had received many honours at the hands of the members of the Institute; during that period he had been concerned very closely with research work on cast iron, and the members of the Institute had honoured him by the award of Diplomas, Branch Presidencies, the Oliver Stubbs Medal, the Presidency of the Institute, and now the E. J. Fox Gold Medal. His pride on such an occasion, therefore, could be well appreciated, and he took the opportunity also to express his gratitude for the overwhelming sympathy extended to him by very many of his friends during his recent illness; the kindness extended to him at that time would remain in his memory throughout his life.

It would be fitting, he continued, to pay tribute to the encouragement and enthusiastic assistance he had received at all times from his many colleagues. Indeed, his initial interest in ironfoundry metallurgy was due entirely to the enthusiasm of two very old colleagues at Richard

Hornsby's 25 years ago; they were Mr. Potts (foundry manager) and Mr. Onions (works manager), whose enthusiasm for foundry work and foundry metallurgy was transmitted to him when a young man and had remained with him ever since. There were many other colleagues also to whom he owed a great deal, for no man could work alone. He was deeply grateful to the members of the Institute for all the honours they had conferred upon him, and Mrs. Hurst and their family shared that gratitude.

MR. BIGG commented that there should be no douots as to the reasons why Mr. Fox had been asked to present the Medal to Mr. Hurst. They were the same reasons as those which had prompted the Institute, on the previous evening, to elect Mr. Fox an Honorary Member. He had done a great deal for the industry (and one could not benefit an industry without benefiting also those who participated in it), and he had taken a lively and practical interest in the Institute. (Applause.)

Vote of Thanks

MR. BIGG, proposing a hearty vote of thanks to the Lord Mayor of Bradford and his colleagues for the welcome extended to the visitors, and for the great help they had given to make the conference a success, said that the Institute appreciated its obligations to them in their personal capacities and as representatives of the great City of Bradford. All attending the Conference had a lively interest in Bradford; they knew that their first West Riding Conference would be a success, and they had already had very tangible evidence from the Lord Mayor and his civic colleagues that Bradford wished them well.

MR. HEPWORTH seconded, and said it was indeed a pleasure to him to second the expression of thanks to the Lord Mayor and the City Fathers—with some of whom he had been apprenticed many years ago in the engineering industry—for their very genuine support of the Conference.

The vote of thanks was accorded with acclamation.

The LORD MAYOR, in a brief response, said it was a source of great pleasure to him and his colleagues that the members of the Institute had honoured Bradford by their presence; he was delighted to welcome them.

Investitures and Votes of Thanks

MR. BIGG invested Mr. Hepworth with the Presidential Badge, which was an earnest of the co-operation of every officer and member of the Institute, and, inviting him formally to occupy the chair, wished him a very happy and successful year of office.

MR. HEPWORTH occupied the chair, amid applause, and he presented to Mr. Bigg a Past-President's badge, with the best wishes of the Institute as a whole, and the hope that he would wear it for many years to come.

MR. BIGG, returning his thanks, said there was a sadness in all finality; he had surrendered an office in which he had been perfectly happy and of which he was thoroughly proud. He expressed his appreciation of the friendship and the kindly co-operation which had been extended to him from every quarter.

MRS. BIGG then performed a happy ceremony which is unusual, if not unique, among technical bodies. It was to invest Mrs. Hepworth with the badge worn by the wife of the Institute's President. In the majority of cases, she said, the tokens worn by wives were emblems of servitude, but the badge she had worn during the past year had proved an exception to that rule; it had given her increased liberty and power over the Institute's immediate Past-President! The badge was a beautiful piece of work—and a thing of beauty was a joy for ever. It would always be a joy to recall the experiences of the past year, which had been very happy indeed, and she expressed her thanks to all who had helped to make it so. She hoped sincerely that Mrs. Hepworth would also enjoy a very happy and successful year of office.

MRS. HEPWORTH, accepting the badge, said that she appreciated the honour it conferred, and would do all in her power to ensure that her husband's year of office as President would be a huge success.

The badges worn by the Senior and Junior Vice-Presidents were then presented to Mr. W. B. Lake and Major R. Miles, both of whom pledged their support to the President in upholding the good name of the Institute.

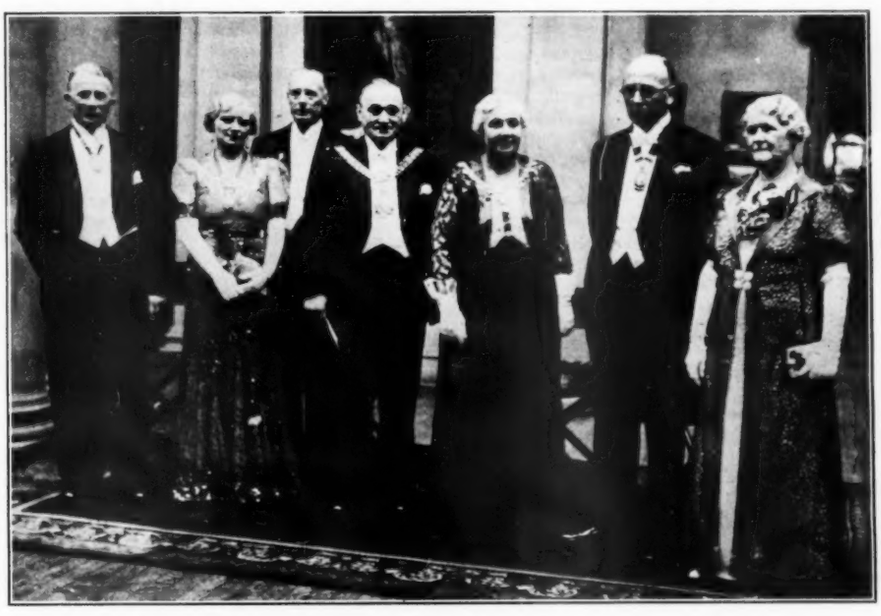
Greetings from Overseas

Telegrams conveying good wishes for the success of the conference were received from Mr. Steinbach, the International Chairman of the American Foundrymen's Association, and from Mr. Sandre, the President of the Association Technique de Fonderie.

Welcome to Overseas Members and Visitors

The PRESIDENT extended a hearty welcome to Herr G. Gürtler, of Frankfurt-on-Main, Germany; Mr. W. Mason (a Member, from Bombay); Mr. Simpson (a Member, from Hong Kong); Mr. Schofield (from India); and Mr. F. G. Williams (from India). The West Yorkshire Branch, he said, would do all it possibly could to extend to them real Yorkshire hospitality, and he hoped their visit to Bradford would prove to be both profitable and pleasurable.

Mr. Hepworth then delivered his Presidential Address.



AT THE CIVIC RECEPTION AT THE CARTWRIGHT MEMORIAL HALL.

Left to right: Mr. J. Hepworth (President-Elect); Mrs. C. W. Bigg; Lord Mayor and Lady Mayoress of Bradford (Alderman and Mrs. H. Hudson); Mr. C. W. Bigg (President); Mrs. Hepworth, and (*at back*) Mr. S. W. Wise (Hon. Conference Secretary).

PRESIDENTIAL ADDRESS

Mr. Bigg and Gentlemen:—

The Presidential Address given to an Institute of this kind frequently makes reference to the last occasion upon which a Conference was held in the same area. No such reference can be made on this occasion, because this is the first time that the West Riding of Yorkshire Branch has had the pleasure of entertaining the Annual Conference. It is a pleasure which has been anticipated by the members of the Branch for a long time; they have put much thought and energy into the preparations, and on their behalf I extend to you all a sincere welcome to the West Riding of Yorkshire, and to the City of Bradford in particular.

Industrially, Bradford is associated in the minds of most people with wool, and quite rightly so, for it is the centre of the largest woollen manufacturing area in the world, and makes the finest material in the world. It is, however, an important engineering centre, and historically it has played an important part in the development of engineering and in the development of iron manufacture.

The changes and developments in the iron industry and in engineering in Bradford are, to some extent, typical of those which have taken place throughout the industrial world. Additionally, Bradford has made an individual contribution of its own to the manufacture of certain classes of iron; I feel that it would be of some interest to review briefly these changes and developments.

Monastic records show that monks were engaged in the extraction and manufacture of iron in and around Bradford from very early times, the monks of Rievaulx Abbey having been granted mineral rights, in districts now part of the city, in the year 1150. From that time onwards the ancient chronicles make frequent references to forges in the locality. Developments on a large scale, however, may be said to date from the close of the eighteenth century.

Early Metallurgical Developments

Although Bradford can hardly be classed as an iron-making district with such districts as, say, South Staffordshire and Cleveland, it has the distinction of being the birthplace of the highest grade of iron in the world. A village, now within the city boundary, has given its name to this class of iron, which is known as "Low Moor iron." In addition to the Low Moor Iron Company, other firms in the district, namely, the Bowling Ironworks at Bradford and the Farnley Company, Cooper Brothers, and the Monkbridge Company at Leeds, embarked upon the manufacture of this class of material under the name of "Best Yorkshire Iron."

No account of the iron industry of the district would be complete without some description of the two famous works already mentioned, namely, the Low Moor Iron Company and the Bowling Ironworks, for they undoubtedly influenced the local engineering industry to a con-

siderable degree, inasmuch as many of the founders of other firms in Bradford served their apprenticeship at one or other of the works.

The Low Moor Company had its inception in 1789, when the Lord of the Manors of Royds Hall and Wibsey was forced to dispose of his estates, which passed into the hands of three gentlemen, Messrs. Hird, Dawson and Hardy. These gentlemen built up the Low Moor Works, which was carried on for one hundred years under their name before it became the Low Moor Iron Company, Limited. The foundation stone of the first blast furnace was laid in 1790. The furnace was built of stone and was 50 ft. high. It was, of course, hand fed, but as early as 1800 a mechanical charging system was introduced, the tubs of raw material being hauled up an inclined plane and automatically tipped. The blast was provided by a beam engine, designed by the company's engineer, Mr. John Smalley, and was built locally by Emmets, of Birkenshaw. It was of the Boulton & Watt type, with a single-acting open-topped steam cylinder, 5 ft. diameter, at one end of the beam, and a single-acting blowing cylinder, 8 ft. 5 in. in diameter, at the other, the stroke being 9 ft. 6 in. in each case. This engine did duty until the erection of new furnaces in 1892, and was preserved in perfect condition at the works for several years after. The new furnaces had capacities of 340 and 240 tons per week, and produced the famous Low Moor cold-blast pig-iron known to all foundrymen.

Coincident with the erection of the first blast furnace, a foundry was opened by Messrs. Hird, Dawson & Hardy. The output during the first few years was mainly colliery tub wheels for the company's collieries, cast-iron rails, pillars and general hardware, but attention was then devoted to the manufacture of cannon and shot, and in 1854 the weekly output of ordnance amounted to several hundred tons. During this period the company also turned its attention to the manufacture of engines, pumps and heavy machine tools, which were made for firms all over the country. It was, however, in the manufacture of the famous Low Moor wrought iron that the company was supreme; the plate mill was the largest in the country, whilst it is interesting to note that the piston rods, crankshafts, crank pins, etc., for the "Great Eastern" were forged here.

A few years ago the works was dismantled; one small portion remains, however, where Best Yorkshire Iron is still made. At the height of its fame the company's collieries covered an area of 8,000 acres, the ironstone mines had 73 miles of underground roads, all laid with cast-iron rails, and the works also occupied a vast acreage.

The Bowling Ironworks

The Bowling Ironworks was established a few years prior to that at Low Moor. The valuable nature of the local mineral deposits was first recognised by several business men, amongst whom were Mr. John Sturgess, of Wakefield, an ironmaster of some repute, and a Mr. John Paley, of Leeds. In 1784, they, with others, set up the first foundry at Bowling for doing foundry and smiths' work, and a brisk trade was done in flat irons, posnets, ovens, boilers, sash and clock weights. It was not until the year 1788, however, that works was established at Bowling for the smelting of iron ore, three years before the sister works at Low Moor. The works was very small during the first few years, but in addition to the domestic products, heavy guns, carronades, howitzers, as well as shot and shell were made. The Bowling cast-iron guns, shot and shell did splendid service at the battles of Trafalgar, Waterloo, the bombardment of Algiers, and at other historic battles on land and sea. Cast-iron guns were made at Bowling up to the time of Sir William Armstrong's invention of the improved wrought-iron guns, and it is interesting to note that some of the first coils to be used by Sir William for the latter were made of Bowling wrought iron.

The commercial enterprise following upon more peaceful times involved equal enterprise on the part of the Bowling Company, which at a later period turned out from their rolling mills large quantities of rods and bars, as well as boiler plates, sheet iron, angle and tee iron, weldless tyres and weldless hoops for steam boilers; from the forges, all kinds of heavy and light forgings, axles, shafts, piston rods, cranks, etc., and from the engineering shops, boiler shops and foundries, the largest classes of factory engines, pumping engines, rolling-mill engines, steam presses, etc. Old hands used to refer with pride to a pair of oscillating cylinders each over 30 tons in weight, and each made in one piece; also to flywheels of ponderous size which were made for various firms. During the late nineteenth century the manufacture of steel was also undertaken, and the steel foundry attained a reputation for steel castings of the largest size. The company's mineral resources were, however, rapidly becoming exhausted, and in 1896 the works was dismantled. Luckily for the local workers the engine shops were taken over by a Dewsbury firm, Bever, Dorling & Company, Limited, who transferred their business to Bradford in 1902. This firm had a world-wide trade in sugar-refining plant, and were also famous for mining plant, their products being found in practically every well-known colliery in the North of England.

Textile Engineering

Normally, the name of Bradford is associated with the textile industry, and the large engineering trade which was carried on in the city in the early part of the century is unknown to the majority of people. About 1900, Thornton & Crebbin were supplying marine-engine cylinders to all the leading shipbuilders in the country in sizes up to 108 in. diameter and 25 tons in weight. It is interesting to note that H.M.S. "Invincible," which was Admiral Sturdee's flagship at the battle of the Falklands; H.M.S. "Thunderer," which fought at Jutland, and the ill-fated "Hampshire," which was lost when carrying Lord Kitchener to Russia, were all engined by the firms to whom Thornton & Crebbin supplied the necessary cylinder castings. It is a lasting testimony to this firm that situated as they were, many miles from the sea, with heavy carriage costs, they were able to compete successfully in such a market. Unfortunately, this concern has passed on, the business being taken over by Cole, Marchent & Morley, which was founded in 1848 by John Cole and James Marchent, both of whom were employees of the Bowling Ironworks. The business was acquired in 1890 by Herbert Morley, who received his training in the Bradford Technical College, being one of the first of the day students. He was instrumental in introducing the manufacture of the Diesel engine in 1911, and his firm also played a large part in the introduction of the "Uniflow" or "central exhaust engine" in this country. In this connection, another local firm, Newton, Bean & Mitchell, shared the honours.

Another famous firm of a few years ago, and one whose name will be familiar to the majority of foundrymen, was Thwaites Brothers, who were identified with the manufacture of steam hammers, forge and smithy plant, Roots' blowers, cupolas, steel converters, ladles and foundry and metallurgical equipment in general. During the war, this firm laid down a large steel foundry for the production of steel castings from the electric furnace, in particular steel wheels for lorries and buses, but the falling-off in demand, consequent upon the post-war depression, brought this venture to an end.

Existing Conditions

At the present time, heavy castings of the type required by the old engine builders are not being produced in the city, but there is, nevertheless, quite a considerable foundry industry, mainly of a jobbing nature, as well as foundries associated with some of the larger engineering firms. There are also several firms which have built up successful businesses in the manufacture of specialities, and although it is difficult to forecast the future development of the foundry industry of the city, prosperity possibly lies in the extension of such specialised manufacture.

It is a curious fact that, with the exception of looms, the machinery in the Bradford trade is obtained almost entirely from sources outside the city, and it is a fact that many advantages would accrue from the encouragement of the machine making branch of local engineering. The success, however, depends on a prosperous textile industry, which is itself a matter of conjecture as regards the future.

The Work of the Institute

The story of ironfounding in Bradford is one which shows many changes—changes which have been made necessary both by developments in the industry itself and by other outside factors. Furthermore, it is probably only representative of the changes which have taken place in the whole foundry industry throughout the country during the last fifty or sixty years. It is to be expected that this Institute, which in a little over thirty years has developed from but a small group of inquiring foundrymen to a strong national body, should reflect the progress of the industry which it serves. Such progress is indicated by the Incorporation by Royal Charter in 1921; the formation of the Technical Committee in 1931, and the foundation of the many medals and prizes which foundrymen have so generously given for the benefit of the Institute and the honouring of its members.

The changes which have taken place in the industry, in its technique and in its methods during the last twenty years, and increasingly so during the past five years, have had their effect upon the personnel. Positions which at the end of the war were considered to be of little importance have developed to-day into posts where a considerable amount of executive ability is required. The growth of specialisation, the application of technical knowledge to the various foundry processes, and the increasing use of mechanical appliances, have created new posts in the industry, and in addition to the foundryman of long practical experience, the industry to-day contains many men who combine experience with technical knowledge.

Since the granting of the Royal Charter in 1921, the Institute has definitely increased its usefulness to its members. For example, the Technical Committee has been in existence for some seven years, and in that time it has been of considerable help to the industry as a whole, and to many individual members. International relations have been established and extended, our own membership has increased overseas, and we have now a flourishing Branch in South Africa. Relations with other scientific associations have been closely cemented, and the Institute has carried out a great deal of work in connection with the development of foundry technical education.

The Annual Reports of the past few years contain particulars of many other developments, some national in character, some comparatively small, but all of them of importance to the industry and the members of the Institute. The immediate value to the individual members of some of the developments to which reference has been made is not always apparent, but the possibilities are not by any means exhausted, and the Council and various committees are at present engaged in investigating various lines of further development with a view to giving increased services to the individual member.

Thus I have entered upon my year of office at a time when, I believe, much of the work which has been carried on during the past few years will be completed, and will be passed on to the members of the Institute and to the industry which it serves. I feel, too, that the

various developments which are at present being formulated, and the new programme of work under consideration, will, when the time comes for me to vacate this chair, have formed some definite step upon which we can safely tread, with the assurance that we have made yet further progress.

In conclusion, I would like to say a word or two about our export trade, realising as I do that it is of vital importance to our existence as a nation. For a moment I will confine my remarks to Empire trade. The Empire possesses as a buying power a population of 500 million people, and I think that every business man and industrialist will agree that a market of that magnitude, bound to us in many ways, such as common policies, tradition and language, is a market that ought to be well worth striving for.

The Empire overseas to-day bought more goods than all the rest of the world, in addition to buying 209 million pounds worth of foreign goods. Some of you may ask what these figures and Empire trade mean to the foundry trade; it means this—if our export trade is strong and healthy, our foundry industry is bound to be in a healthy condition. Therefore, let us try to do all we can to develop mutual confidence and sympathy, so far as is practicable with our Empire overseas; the world is by no means a saturated market, especially within the Empire, and if we here at home do not seek this increasing trade, other countries will.

The main conditions of industrial welfare and expansion are security and the confidence which flowed with it, and these must be based upon peace amongst the nations of the world, and all factors operating against peace must be removed and overcome if our industry or any other industry is to go forward.

MR. BIGG proposed a hearty vote of thanks to the President for his address, which included a most interesting historical survey of the founding industry in Yorkshire and some thoughts on the outlook for the future.

The vote of thanks was carried with acclamation, and the President briefly responded.

The reading and discussion of Papers was then proceeded with.

The Annual Banquet

Many distinguished guests were welcomed at the annual banquet, which was held on Wednesday evening, June 15, in the Connaught Rooms, Bradford. The President and Mrs. Hepworth, with the Lord Mayor and Lady Mayoress, received the members and guests, who enjoyed a very happy evening. The speeches were commendably short and of the right tone for such an occasion, and ample time remained for dancing, which continued until 1 a.m.

The guests included Sir Anthony Gadie; Alderman J. W. Longley, J.P.; Mr. H. Holdsworth (M.P. for Bradford South) and Mrs. Holdsworth; Alderman S. Horsfall, J.P., and Miss Horsfall; Captain L. J. Sarjeant, O.B.E., and Mrs. Sarjeant; Principal H. Richardson (Bradford Technical College); Herr G. Gürtler, of Germany (author of one of the Exchange Papers presented to the conference); Mr. F. G. Williams, from India, and Mr. Simpson, from Hong Kong.

The Toasts

The Loyal Toast having been honoured, the PRESIDENT proposed "Our Guests," and said that they were distinguished in many walks of life. In the first place, he mentioned the visitors from overseas—Herr Gürtler, of Germany; Mr. F. G. Williams, from India; and Mr. Simpson, from Hong Kong. There were also distinguished representatives of the City of Bradford, whom the members of the Institute were delighted to welcome. In a tribute to the Lord Mayor and his colleagues in the City Council, he said he had wondered what was the main reason for their spontaneous generosity on the occasion of the Bradford Conference, and had concluded that it was the fact that the Institute was intent upon developing the practical and scientific sides of the industry, for the Bradford City Council had always been pioneers in matters of education. He paid tribute to Alderman Horsfall as a stalwart of the City Council; and to Alderman Longley, the Chairman of the Technical Education Department, and to his Committee, who had placed the Technical College at the disposal of the Institute for the purpose of its meetings, and would entertain them the following evening.

There followed tributes to Mr. A. S. Worcester (President of the West Riding Branch of the Institute), Mr. H. FORREST (Chairman of the Conference Committee), Mr. W. G. Thornton (Hon. Conference Treasurer), and Mr. S. W. Wise (Hon. Conference Secretary), and all others who had contributed to the organisation of a pleasant and successful conference. He hoped the guests would retain many pleasant memories of the conference, and he coupled with the toast the name of the Lord Mayor of Bradford.

The LORD MAYOR, in his response, said that he and his colleagues on the City Council were happy to be present and to wish the Institute well. In a reference to industrial affairs in Bradford, he said they had been under the impression that when the iron and steel trade was busy, prices in the wool trade were good. But at present, for the first time in 50 years, he was told, although the iron and steel trades had been busy making money, the soft goods trades had been losing money.

However, he and his colleagues and fellow guests were grateful for the manner in which they had been entertained, and were enjoying a happy evening in good company.

The Engineer and the Foundry

CAPT. L. J. SARJEANT, O.B.E., proposing "The Institute of British Foundrymen," made a brilliant speech, in which he said that when he was asked to propose the toast, his first reaction was to refuse, on the ground that there were others more competent than he; but after a little thought it had appealed to him as a pleasure, for he occupied a very interesting position, inasmuch as he was closely in touch with the foundry, though definitely he was not of the foundry. Therefore, he had delved into the archives of the Institute and had read a number of its Papers.

The foundry, he continued, was one of the most important, if not *the* most important part, of the works which he controlled, and his contact with it was of intense interest. Its products were needed in every portion of the things which his organisation produced, and they were needed at a very early stage. On occasions, when checking production, he was told that manufacture was behind plan because castings could not be obtained from the foundry. When he went to the foundry to find out what the trouble was all about he found that, whereas

THE ANNUAL BANQUET OF THE INSTITUTE, AT THE CONNAUGHT ROOMS, BRADFORD.

for weeks or months it had produced certain castings successfully, similar castings were being produced with their vital parts somewhat like Gruyère cheese. He was told that the metal used was of the same analysis as that used formerly, that the temperatures were the same, that the bond and permeability of the sand were the same, and that the work was done by the same men, using the same machines. Thus he was faced with the interesting position that all the details were exactly the same as formerly, but the products were entirely different! If he accepted that—(laughter)—he would have to conclude that there was some factor of the foundry which was outside our normal three-dimensional world; in other words, that there was an evil spirit about, and it would be reasonable to seek some means of propitiating that evil spirit. That reminded him that the Romans—who were very capable people, though somewhat superstitious—when banqueting, always spilled the first glass of wine and muttered the exhortation, "Be propitious, O Bacchus." It tickled his sense of humour to visualise a Foundry Superintendent, surrounded by his attendant satellites, solemnly pouring the first ladle of metal on to the floor and saying, "Be propitious, O Tubal Cain." (Laughter.)

However, he was intensely interested in the art of the foundryman, because when difficulties such as he had mentioned did arise, it was always found that there had been some change, though perhaps only a very small change, in the production of the castings. For that reason he could see clearly the part which the Institute must play in the development of a great industry. To him, although an outsider, successful founding was clearly a matter of extreme accuracy and intense precision, and he did not see how it was possible for the industry to progress as it must and would do without the help of the Institute, which was controlling, centralising and distributing knowledge. The foundry was the beginning, and it remained the foundation, of the engineering industry, and he visualised that the part it played would be woven more and more deeply into the structure of the nation and of industry as a whole in the future.

The part played by the engineering industry in the future would be similar to that of the doctors of the medical profession. When discoveries were made and difficulties were overcome by doctors, the results were made known immediately to the whole profession, to be used for the benefit of suffering humanity. Similarly, when difficulties were overcome in the future in the engineering world, the information derived would be made free to all engineers, for the benefit of suffering industry; and, as the result of delving into the archives of the Institute and reading Papers presented to its members, he felt that the founding industry was perhaps further along that road than was the rest of the engineering calling.

Finally, he said he had heard the foundry referred to as the Cinderella of the engineering industry; and he liked that reference, because Cinderella was a very worthy and hard-working person. She was also very beautiful, and one priceless asset she possessed was a Fairy Godmother. If the foundry were the Cinderella of the engineering industry, then the Institute was the Fairy Godmother; and he believed the Institute could do for the foundry as much as the Fairy Godmother had done for Cinderella.

MR. C. W. BIGG (immediate Past-President) said he was honoured to be asked to respond to the toast, proposed so ably, wittily and gracefully by Capt. Sarjeant.

Commenting jocularly on the foreword of the Conference handbook, he said he had no knowledge of its authorship, but it stated that in West Yorkshire the chief metallurgical activities in the very early days were with lead; that might help to trace the origin of the process of oscillation or "swinging" of that metal! (Laughter.) However, he did not wish Capt. Sarjeant to take that remark too seriously, for he was convinced that the particular type of foundryman to whom it might apply was extinct!

Expressing appreciation of the kind references made to the activities of the Institute, he said that when he was installed as President, a year ago, he had had a very great affection and respect for the Institute, and as the result of his year of office his respect and affection for it had become greater than ever. The Annual Report on the work of the Institute, which had been presented at the Bradford Conference, the reports submitted to the annual meetings of the Branches throughout the country, and the evidence he had observed during his visits to the Branches, all testified to the existence of a spirit of enthusiasm which was a credit to such a body of voluntary workers. That a large number of men, who were already very busy, should devote time and effort, and to a considerable extent their money, not only to increasing their knowledge of their own particular jobs, but also to passing on their knowledge to others, was an ideal state of affairs, worthy of the admiration of everybody.

The Institute had achieved a great deal. But one of the factors in its working which he had noted was the existence of what might be called a form of divine discontent, which expressed itself in an urge on the part of its members not to allow themselves to be satisfied with their accomplishments, but to strive all the time for new and greater achievements. They could not stand still; the conditions and circumstances by which they were surrounded were continually moving, and unless they as an Institute kept pace with progress they would go back. They could claim to have taken a very large share in the developments which undoubtedly had taken place in the industry during the last two or three decades. Whatever the opinions they held with regard to any one particular problem which faced the Institute, the members were unanimous in their ambition to ensure that the Institute should continue to be among the leaders—and he had every confidence that that ambition would be realised.

Presentation to Mr. Wise

After the formal speeches, a presentation was made by MR. A. S. WORCESTER (President of the West Riding Branch) to Mr. S. W. Wise (Hon. Conference Secretary) in recognition of his hard work in connection with the organisation of the conference. Mr. Worcester said he was particularly happy to have the opportunity to make the presentation, for he had been a colleague of Mr. Wise 30 years ago in Messrs. Willans & Robinson, of Rugby, and it was a pleasure to be associated with him also in the West Riding Branch. The organisation of the conference had entailed an enormous amount of work, the three outstanding personalities in connection with which were Mr. H. Forrest (Chairman of the Conference Committee), Mr. Thornton (Hon Conference Treasurer), and Mr. Wise, who was the ideal Secretary of the West Riding Branch.

In making the presentation, which took the form of a tankard and a cheque, Mr. Worcester wished Mr. Wise good health, and "strength to his elbow."

MR. WISE, in expressing his thanks, said he had been a member of the Institute for many years, and had always enjoyed contact with his fellow members; never had he worked with colleagues with such unanimity as had been in evidence throughout the organisation of the conference. He could not have carried on without the active support of all of them.

Presentation to Mrs. Bigg

A second presentation was made by the PRESIDENT to Mrs. Bigg for the part she had played in making Mr. Bigg's year of office so successful as it had been. It took the form of a pair of silver candlesticks and an ashtray, which were a token, he said, of gratitude to Mrs. Bigg for having kept her husband in order, for having looked after him, and for having accepted his excuses and apologies when he had arrived home late after attending Institute meetings up and down the country! He hoped that the gift would recall to her mind in the future many pleasant memories of the past year of office.

MRS. BIGG, in response, made another of the happy speeches for which she is becoming noted. There was a time in the dim and distant past, she said, when she had held a very different view of the members of the foundry fraternity from that which she held at present. She had looked upon them from afar—askance, as it were—as a dour, serious-minded, level-headed, rather unapproachable and very sober crowd. Fortunately, she had since changed her mind. Having lived with one of them for nearly a quarter of a century, and having come into close contact with many others, she had come to know them for what they were—hale, hearty, considerate, sometimes almost gallant, well able to grasp whatever came within their reach!

Such jocular remarks, however, did not detract from her obvious sincerity in expressing thanks for the charming gifts presented to her, which would remind her always of a host of very valued friends.

Following the banquet, the members and their ladies enjoyed dancing until a late hour.

CONVERSAZIONE AT BRADFORD TECHNICAL COLLEGE

Members and ladies, together with a number of distinguished citizens of Bradford, were entertained, on Thursday evening, June 16, to a conversazione at the Technical College, at the invitation of Alderman J. W. Longley, J.P., Chairman of the Technical Education Sub-Committee, and of other members of the Committee. Guests were received in the main hall of the College by Alderman Longley, and by the President and Mrs. Hepworth.

The various departments of the College were then inspected under the guidance of students, and demonstrations were arranged in each department by the members of the staff and senior students.

This College is one of the largest technical colleges in the country, and is well equipped for the teaching of a variety of subjects. The textile department aroused considerable interest, for it is particularly well equipped and is housed in a large modern separate building. It is a self-contained textile works, equipped with the latest machinery for the manufacture of woollen cloth.

The evening's programme included dancing in the College Hall, which was beautifully decorated by the Bradford Corporation Parks Department, and the company were entertained to refreshments by their hosts. At an interval in the proceedings, MR. J. HEPWORTH, the President of the Institute, expressed to Alderman Longley, and his colleagues on the Technical Education Sub-Committee, his thanks for their hospitality. ALDERMAN LONGLEY responded and expressed the pleasure of himself and his colleagues at the opportunity of entertaining the Institute.

EXCURSION THROUGH THE DALES

As is customary, the last day of the Conference was given over to an excursion, and this took place on Friday, June 17, enabling the party to see some of the most beautiful scenery in the Yorkshire Dales.

(*Concluded on page 526.*)

Conference Visits to Specialised West Yorkshire Foundries

The foundries inspected by members of the Institute of British Foundrymen during the course of last week's annual conference in Bradford are each specialists in a particular field. Textile and hemp spinning machinery, piston rings, machine-tool castings, steel castings and valves typify the major activities undertaken. The writer of the descriptions which follow wishes to express his sincere gratitude to the directors, managers and foremen for the courtesies accorded and the help given in their preparation

J. Blakeborough & Sons, Limited, Brighouse

These works were established in 1828, and have grown from back-street property to the present size, covering some 13½ acres. It will be realised, therefore, that the foundry department has had to be augmented from time to time, and is not housed in one large building. On account of the positioning of the cupolas, roughly centrally, which breaks up the continuity of the buildings, the real size of the foundry is somewhat masked to the casual visitor. It is, however, a mistake to imagine that foundries housed in one huge rectangular building are easier to manage and more economical to operate. The reverse is often the case. More often than would be imagined, an iron foundry attached to an engineering works is an aggregation of self-contained manufactories, except for certain common services, such as the supply of liquid metal and sand. Where difficulty is experienced in linking up a section with these services, auxiliary ones are often provided. These conditions in general can be said to exist at the Blakeborough foundry, where there are two sources of supply of both liquid metal and sand, whilst there are two fettling shops, one at each end of the foundry, the one equipped for handling light and the other for heavy castings.

Handling Raw Materials

Raw materials enter the foundry both by rail and road. That coming by road passes over a platform weigh-bridge capable of accommodating the largest type of motor lorries now in use. The works locomotive brings the raw materials to a siding opposite the main cupola plant, where they are unloaded into bins in the stockyard. The cupolas are not placed at the foundry outer wall, as is usual, but are set well back, at the end of a "lane." This permits the "lane" to be spanned by an overhead electric travelling crane, which also covers the stockyard. It carries an electric magnet for dealing with the scrap and pig, which are carried direct to the cupola platform, there to be weighed in dial weighing machines prior to charging. This crane also handles the bulk of the sand by grabs, replacing the magnet, and discharges its load into shutes to fill the various sand bins situated on the right-hand side of the "lane." Coke and limestone are taken up to the cupola stage by an electric hoist. Advantage is also taken of this position to include at the side of the cupolas a large core stove so that the fuel for its firing needs but a minimum of handling. The smaller cupolas are situated some 200 ft. away from the larger plant. Here, the line of the outside wall of the foundry takes up a new position to increase the overall width of the foundry by about 20 ft. Two small cupolas are placed between the two walls and their servicing is alongside the outer wall of the foundry. Charges are prepared and loaded into stillages on the ground floor, to be taken by an efficient electric block to the cupola stage, where the contents are automatically discharged.

Melting Plant

The two large cupolas, one of which is provided with a receiver, are of 6 to 7 tons per hr. capacity. These furnaces serve the main foundry and a part of the machine foundry. The two smaller ones have a capacity of 2½ tons per hr.

Sand Preparation

This service is divided into two sections. That for the large foundry, including loam, is mixed in two large mortar-type mills, and is distributed by petrol-driven trucks and stillages. For a small mechanised section of the machine foundry, synthetic sand, based on bentonite and silica sand, is prepared in an August Simpson mixer. This is furnished with sand from a central knock-out, via an underground belt, and belt and bucket elevator. Above the mixer is the usual hopper to allow of batch mixing. The sand, on leaving the mill, is aerated, and is taken by a bucket elevator to a belt conveyor, from which the sand is ploughed off to feed three Zimmermann jolt-squeeze and turnover machines.

J. BLAKEBOROUGH & SONS—METHOD OF HANDLING RAW MATERIALS (PIG-IRON, SCRAP AND SAND).

Each year all the furnaces are rebricked and are patched up daily with ganister. All the furnaces make Grade E Meehanite iron, yielding an average tensile strength of 20 tons per sq. in. and correspondingly high transverse figures.

Handling Liquid Iron

All metal from the large cupolas is carried to the moulds by the overhead cranes, ranging from 10 cwts. to 10 tons capacity. For the smaller plant, bogey-type ladles are used. These vary in capacity from 5 to 15 cwts. For small castings the metal is transferred into 1-cwt. shanks. The conveying plant was supplied by North Acton Conveyor & Elevator Company. The removal of the moulds and the return of the empty boxes are effected by a simple system of gravity-roller conveyors. Zimmermann jolt machines are successfully used for the ramming up of 30-in. valves.

Core-Making

The bulk of the sand used in core-making has as its base old floor sand, which has been crushed and desilted in a special plant. After this preparation, it is mixed with oil in the usual way.

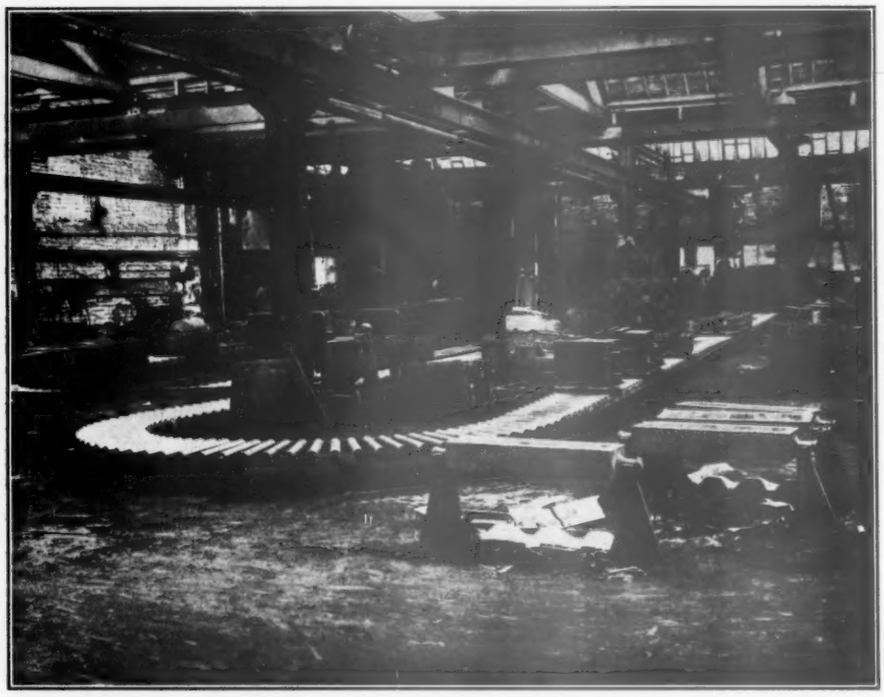
This material is used for the cores for valves up to 6 in., the cores being made by female labour, using pneumatic rammers. The cores are conveyed from the bench to the stoves by gravity conveyor. The stoves used for this purpose are the August multi-rack type. Many of the core plates used are of the compressed-asbestos type. Because of their non-warping character, they are finding increasing favour in many core shops. Cores for the larger valves are hand-rammed.

General Features of the Foundry

The foundry buildings are of substantial construction, being built of Yorkshire stone with slate roofs allowing ample skylight illumination, and louvred ventilation throughout. The main bay, served by the two large cupolas, is 379 ft. by 38 ft. by 17 ft. high to the crane rails, along which run four overhead cranes. At right angles to this main bay is the floor moulding bay, with an overhead crane running out into the yard, which affords facilities for the handling of the large boxes in and out of the shop, whilst large castings can be removed to the fettling yard.

The machine foundry covers an area of 11,700 sq. ft. The shop is of the modern apex roof type carrying louvred ventilation. It is served by five floor-operated overhead cranes and has, as previously mentioned, its own cupola plant. There are two fettling shops; the one for the main foundry, dealing with the large castings, is well equipped with an overhead crane and a shot-blast room. The other is adjacent to the machine foundry, where the small castings are cleaned by rumbling. The barrels are totally enclosed and are furnished with dust-extracting apparatus, which also serves a battery of double-headed grinders. An interesting addition to this section is a conveying plant for old sand for re-use. From here the castings pass into the casting stores, and from there straight to the machine shop.

The foundry lighting, which, by the way, was reconstructed in 1929, is carried out by Benjamin fittings, calculated to give a floor lighting of 10.5 ft.-candles. The heating system is by Thermolier fan-heaters, which are in course of being installed. These are thermostatically controlled, both on the steam supply and electrically.



J. BLAKEBOROUGH & SONS—THE MECHANISED SECTION.

Patternshop

A large, essentially-modern patternshop, with its two acres of pattern storage, is placed adjacent to the foundry. It is well capable of supplying all the demands placed upon it for both wooden and metal patterns.

Technical Control

This service is divided into three distinct sections. The chemical laboratory, situated near the main gate, quite close to the foundry, determines the composition of all the raw materials entering into production, controls processing, and passes the analysis of the finished product. In addition, micro examination, calorimetry and *p*H determinations are also carried out as routine testing.

The second section, that of mechanical testing, is carried out in a separate building. Here, the usual tensile, transverse, hardness and other tests are made. The final section, that of sand testing, is housed in a corner of the machine foundry, and is equipped with the standard A.F.A. apparatus.

Welfare

The Blakeborough company is justly proud of its large and efficiently-conducted welfare department. The canteen is particularly popular with the operatives, on account of its efficient service and low prices. In addition, checks are given for all purchases made, and those who spend the most receive the greatest dividend. Milk or beef extract is served to all operatives during the morning. The Safety-First Committee is made up of representatives from each shop. It supervises, *inter alia*, a well-equipped ambulance room and clinic. A further activity is the Works Fire Brigade, which has recently added to its equipment a new fire engine and ambulance tender. Finally, there is a sports club for the staff and workpeople, with full facilities for cricket, football, tennis and bowls.

Conclusion

The foundry is operated on a 47-hr. week basis, which eliminates all Saturday work, except for the necessary maintenance work, which can be more efficiently carried out when normal production is arrested. There is an atmosphere of ordered and logical progress, rather than revolutionary change, in the Blakeborough foundry. Extensions are still under consideration, but a wholesale revamping is rightly deemed unnecessary.

Thomas Broadbent & Sons, Limited, Huddersfield

The foundry department of this works is situated on the opposite side of the road to the main works. From the foundry angle it can be regarded as a jobbing shop, and its particularly intelligent operation is worthy of emulation by dozens of other foundries throughout the land.

Raw Materials

Pig-iron, scrap and coke are received from the London Midland & Scottish Railway by motor-lorry delivery. The pig-iron, after being broken, is taken by electric hoist to the cupola stage, which has a storage capacity of 200 tons.

There are two cupolas, each having a single row of tuyeres. One is of 4 tons per hr. capacity, and the other of 5 tons, and both are provided with receivers. A feature not often encountered is the installation of a water-quenching apparatus to deal cleanly and expeditiously with the cupola dump.

The foundry building, which is entirely surrounded by spacious yards, consists of three bays, giving a total area of 26,000 sq. ft. For general transport there are two Broadbent electric overhead travelling cranes in each of the two larger bays, and one in the smaller bay. These are supplemented by a number of wall jib cranes carrying electric travelling blocks. Dry-sand, green-sand and loam moulding are all undertaken, and for actual moulding a good deal of reliance is placed on a portable Sandslinger. In addition there is the latest type of Zimmermann jar-ram turnover machine and a number of others, all served by a centrally-situated air compressor. For the drying of moulds and cores, there are four coke-fired forced-draft stoves, each of which is provided with a carriage moved in and out by an electrically-driven Broadbent capstan.

Sand Control and Preparation

The objects sought and the results achieved in this foundry have recently been dealt with by Mr. S. Carter and Mr. A. W. Walker,* and as their description constitutes such a complete survey all that is necessary here is to give details of the actual plant, for which Pneulec, Limited, have been entirely responsible. Wherever possible, the castings are knocked-out at one of the three gratings provided along one end of the shop. Where this is impossible, then the sand, no matter whether it be dry, green or loam, is transferred to these knock-outs. If it be caked, it is broken by rammers and forced through the grating.

The three knock-outs are positioned over hoppers which feed a 20-in. wide troughed belt running between 96-ft. centres. This belt spills into the boot of a belt and bucket elevator, which raises its load a matter of 19 ft. in an annex to

* FOUNDRY TRADE JOURNAL, May 26, 1938, pp. 423-8.

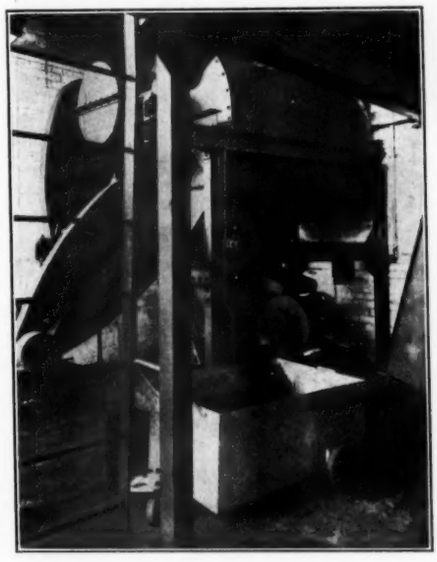
the main foundry building. The sand is discharged into a rotary screen, 3 ft. in diameter and 6 ft. long. It is carried on a centre shaft equipped with self-aligning ball-bearing pedestals. The overmatter falls down a shute to fill a portable container. The screened sand falls on to a shaker feeder which distributes it over the surface of a 16-in. diameter, 18-in. wide "Rapid" magnetic separator. The tramp iron is collected in a small metal box and the sand falls into the boot of a second bucket and belt elevator running between 38-ft. centres.

New sand is added by shovel to each batch mixing according to the specification imposed by the management.

The mills are 6 ft. diameter and are provided with stirrers, which revolve in themselves. They travel round the pan—a method which ensures adequate mixing and effectively prevents caking. The rollers themselves are adjustable as to the clearance between their surface and the pan bottom.

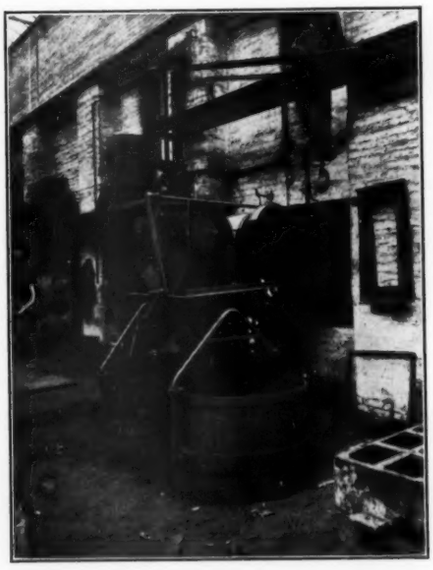
The water additions, which are made by means of a spray running around the edge of the mill

STORAGE HOPPER RECEIVING SAND FROM FOUNDRY.



PART OF THE SAND-PREPARING PLANT.

PREPARED SAND LEAVING EITHER MILL FOR BELT DELIVERY TO FOUNDRY.



TIPPLE SHUTE FOR DELIVERY OF SAND TO FOUNDRY.

THOMAS BROADBENT & SONS.

This elevator spills by means of a butterfly valve into one of two well-elevated 10-ton storage hoppers. Beneath them are the sand mills, but interposed between the hoppers and the mills are measuring hoppers, the feed to which is controlled by undercut chop gates operated by geared quadrants and hand levers. New sand is stored in an open-bottomed cylindrical hopper alongside, and the second elevator is so arranged that it can be used for filling either the system-sand hoppers or the hopper storing the new sand. sides, are meter-controlled, there being a separate meter for each section of the plant. The discharge from the mill passes the sand through a disintegrator and the layout is such that both mills feed into a common hopper situated immediately above an inclined belt conveyor 24 in. wide and running between 16-ft. centres. This carries the sand back into the foundry to fill a hopper with a two-way tipple shute. Provision is made for two tub skips to rest at this point for transferring the sand to its point of use. The whole plant is push-button controlled, with conveniently-placed stops for closing it down completely in case of emergency.

By the intelligent use of this plant, an excellent control is being kept upon the whole of the properties of the sands used, for both green and dry-sand work. As the disintegrators and conveyors are not at all suited for the handling of mud, recourse is had to the original sand plant for the preparation of loam. For this purpose, prepared green sand is taken to an ordinary pug mill, and to it is added new Hensall sand, water and a modicum of horse manure.

Thus, it is evident from the above and a study of the Paper previously referred to, that it is possible for a jobbing foundry completely to rationalise its major problem—that of sand handling and the control of its physical properties.

Non-Ferrous Foundry

This is housed in a separate building at the rear of the iron foundry. Most of the work undertaken is either in brass or bronze. Melting is carried out in five town-gas-fired pit furnaces, worked so as to give a slightly oxidising flame, probably to avoid hydrogen contamination. Most of the work done is such that it can be handled by bench moulding, and an overhead traveller is installed for the heavy castings weighing up to 1,000 lbs. There is a well-equipped patternshop replete with all the usual woodworking machinery.

Heating, Lighting and Ventilation

The foundry during the winter months is heated by hot-water pipes fed from a central boiler, the water being circulated by pumping. The shops carry patent glazed roofs, and artificial lighting is provided by powerful roof and wall lights. The foundry is well ventilated by louvre ventilators, running the entire length of each roof, supplemented by exhaust fans placed at the ends of each bay. A well-equipped canteen is provided, together with ambulance room, and there are special educational facilities for the apprentices.

British Standards Institution

Mr. Ronald C. Cross, M.P. (Parliamentary Secretary to the Board of Trade), in proposing the toast of the British Standards Institution at the annual luncheon, in London last week, referred to the great diversity of interests which come under the ægis of the Institution, and directed attention to the advantages which accrued to both manufacturer and user from the use of nationally-agreed British Standards. Dr. E. F. Armstrong, F.R.S., retiring chairman of the British Standards Institution, replying to the toast, and emphasising the wide significance of the work of preparing British Standards, called special attention to the impressive co-operative spirit which prevailed throughout British industry, and which made possible the preparation of the very large number of British Standards. He pointed out that the hundreds of committees—with over 18,000 members—now actively operating under the ægis of the Institution and holding 1,100 odd meetings during the year, represented a voluntary contribution, quite without parallel, in assistance to British industry generally. Dr. Armstrong also called attention to the very large expenditure incurred by many industrial firms in carrying out research work for the benefit of the Committees and urged the Board of Trade to impress upon the Treasury the need for substantially increasing the grant of the Government to the Institution. Sir Frank Heath, chairman for the ensuing year, paid tribute to the great services Dr. Armstrong had rendered during his two terms of office.

Simultaneous Estimation of Mn, Cr, and V

P. DICKENS and G. THANHEISER, in Report No. 125 of the chemical sub-committee of the Verein deutscher Eisenhüttenleute, published in the "Archiv für das Eisenhüttenwesen," describe the principles and procedure of a simplified method for the simultaneous estimation of Mn, Cr and V in tungsten-free and tungsten-containing steels.

Fairbairn Lawson Combe Barbour, Limited, Leeds

This firm, which has associated works in Belfast and Dundee, specialises in the manufacture of machinery for dealing with jute, sisal and other fibrous materials used for making textiles. The building of heavy, high-grade machine tools is also a prominent part of their activities and is a department which is extending. One of the major machines used for jute spinning carries something of the order of 15,000 components, most of which are grey-iron castings. It will thus be apparent that a well-organised foundry, capable of giving a large yet flexible supply of easily-machinable, yet wear-resisting castings, is essential, as such materials as jute and sisal are fairly abrasive.

FAIRBAIRN LAWSON COMBE BARBOUR, LIMITED—GENERAL VIEW OF THE HEAVY FOUNDRY.

Melting Plant

Raw materials enter the works along a roadway situated at the back of the foundry. Pig-iron, scrap and coke are loaded from the bins into skips which are picked up by a Smith of Rodley jib crane and placed on the cupola stage. After being carefully weighed, they are made up into charges varying in weight according to the cupola in operation. There are four cupolas, two of 4 ft. 6 in. diameter and two of 3 ft. They are of the standard Thwaites "Rapid" type, and are blown by Roots blowers. The blowing house is on the ground floor and either of the two blowers installed can take care of any two furnaces blowing simultaneously.

Core sand is also brought on to the cupola stage and from there it is transferred to a floor spanning the roofs of the mould drying ovens. This floor, being a grating, allows the sand to be distributed for drying purposes over the area of the mould and core stove roofs. Provision is made for its easy transport to the core shops.

Moulding Bays

In general there are four bays, and the character of the work undertaken becomes progressively larger from right to left, looking at the foundry from the cupola stage. Thus the first bay, which, at the cupola end, includes the large mould and core stoves, is serviced by two 15-ton cranes. About four-fifths of the way down the bays is a clear wide road and the area beyond this road is used, opposite the first bay, for the reception of "inwards" patterns. Later, this area serves for fettling the heavy castings, and farther along is a section of the machine moulding department. Along the outer wall of the first bay there is a series of pits for the making of carding cylinders. Meticulous care is essential in their production, and loam moulding is used, therefore, for any surface defect has a deleterious effect on the fibre of the fabric. Lathe beds and other large castings are also made in this bay, and in the second one.

The second bay is provided with a 10-ton and a 5-ton overhead traveller, whilst the third has two of 3-ton lifting capacity. An interesting section here is devoted to the manufacture of the frames of the machines. They are of a straggling thin character and require boxes about 6 ft. by 4 ft. The boxes are of the hinged variety, but the hinge is open on its top side. The output from this method of working is eminently satisfactory. At the cupola end of this bay are a pair of Osborn jar-ramming machines.

The remainder of the foundry makes vast quantities of small castings, and youths are employed for the operation of large numbers of simple home-made stripping plate machines. A good deal of ingenuity has been put into the design of these, and in one case the threads of a worm are given to the mould by a screw draw mechanism. There are some dozens of Darwin and Sellars types of machines doing good service. This light castings bay is of considerable size, and installed along the furthermost wall is a series of Wilsons and Mathiesons' moulding machines. At right angles to the wall, and between two parallel lengths of steel bar, a level bed is swept. On the moulding machine table, the box is placed over the pattern-plate. The box is filled with sand by shovel and tucked under the bars. After well filling the box, a lever is pulled, which slides forward a heavy serrated roller, resembling a miniature "tank." After two or three rapid passes of this roller, the pattern is stripped, and the mould then placed on the prepared bed.

Sand Preparation

As in many mechanised foundries, a modicum of new sand is placed on each mould, for keeping up the bond. The general question of sand preparation, both for moulds and cores, is at present having the attention of the management, and will be reorganised in the near future. This department, together with the light core-making, is situated at the cupola end of the building, adjacent to the machine-moulding section.

Leading from this section, at the opposite end, is the fettling shop, housed in a separate building, where much of the production lends itself to cleaning by barrelling. When the barrels are in operation, they are enclosed by a wooden housing to minimise noise. The whole depart-

FAIRBAIRN LAWSON COMBE BARBOUR, LIMITED—POURING ROLLER CASTINGS.

ment is well served by dust-extracting apparatus, and the grinding and other machinery is well laid out.

Non-Ferrous Foundry

This, too, is separately housed in a shop leading off from the core-making corner of the light-castings bay. Here, there is a battery of coke-fired pit furnaces and again good use is made of the strickled level bed for making flat-backed castings. Both light alloys and those based on copper are made.

Conclusion

This foundry is one which is particularly well organised. The production is such that definite areas of the foundry can be allocated to the production of one particular type of casting. Naturally, the various sections have to embrace a measure of elasticity. Wherever possible, the patterns are mounted on plates, and in their construction and design the art of the founder is seen at its best.

FAIRBAIRN LAWSON COMBE BARBOUR, LIMITED—GENERAL VIEW OF LIGHT FOUNDRY.

John Fowler & Company (Leeds), Limited

It is frankly admitted that this foundry, which has been in operation since 1873, is now in the condition which geologists would designate metamorphism. Since its inception it has been admirably suited for the manufacture of winding and stationary engines, road rollers, and ploughing engines and locomotives, but with the march of progress, steam has been superseded by the petrol and Diesel types of engine, and the firm now produce a range from 1½ h.p. to 180 h.p. suitable for all types of industrial work. Some new plant has been installed, whilst the modernisation of the melting and sand-handling plant is under consideration. The actual buildings are excellent, being lofty and well lighted, and having splendid natural ventilation.

Pig-iron, scrap and coke arrive at a position near the cupola and sand-preparing plant by private sidings and by lorry. A unique feature of the cupola plant is the provision of two stages, one above the other, to take care of the difference in the levels of the charging doors of the larger and smaller cupolas.

JOHN FOWLER & COMPANY—GENERAL VIEW OF THE FOUNDRY.

Altogether there are four cupolas. Two are of 4½ to 5 tons per hr. capacity and are furnished with receivers. They have an inside diameter of 39 in. and are blown through two rows of tuyeres by Roots blowers at a pressure of 10½ ozs. The total cross-sectional area is 200 sq. in. The two smaller ones are not provided with receivers. The cupolas are obviously well controlled metallurgically and are yielding satisfactorily hot iron. The raw materials are taken to the charging platforms by an hydraulic hoist.

The main sand plant is situated against the siding and just outside the main foundry building. Sand is milled in an ordinary pug mill, but extensive use is made in the foundry itself of Royer mixers.

The foundry is divided into two main bays, each 48 ft. wide, one being 300 ft. long and the other 450 ft. Each bay is serviced by an overhead electric travelling crane, and these are supplemented by a number of jib cranes attached to the pillars.

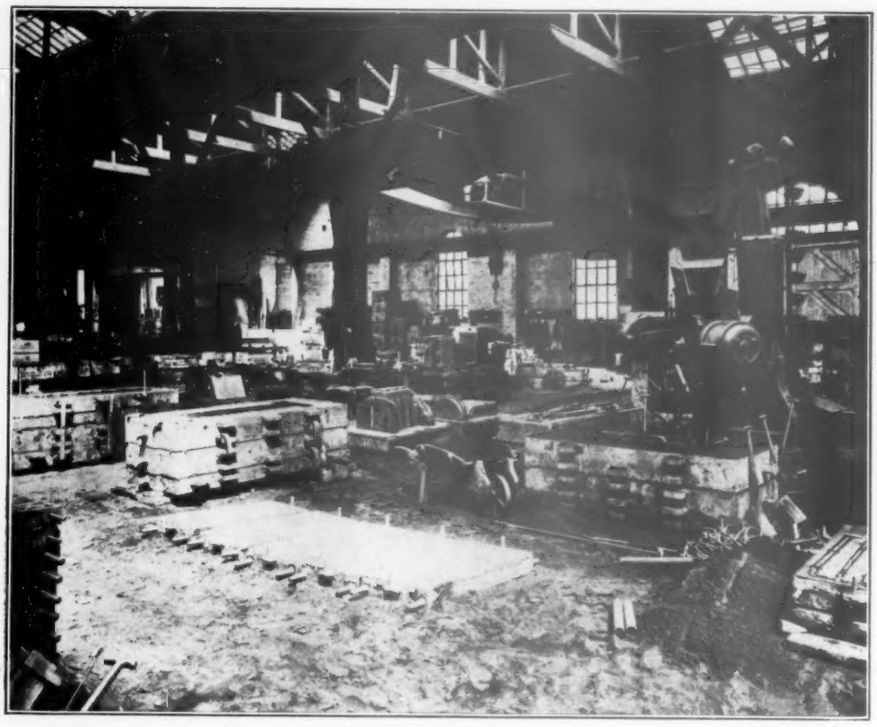
Much of the moulding is carried out by the Sandslinger, and in this connection there is a nice arrangement of surrounding it with a track along which run low trucks carrying the moulding boxes. This arrangement materially lessens the duty placed upon the crane. An Osborn roll-over machine has recently been installed, and that is serviced by a roller pathway; this pathway passes through a brick wall for carrying moulds to the coring-up bay, when the machine is engaged on Diesel-engine cylinder work. Additionally, there are a number of hand-ram machines. Obviously, for Diesel-engine work, an extensive core department is essential and there are four stoves capable of giving an output of 40 tons of dried cores per week. Centrally situated between the four core stoves is an Acme stove for over-firing, using a forced-draft system.

Fettling Shop

This shop has to deal with both large and small castings, and the plant provided ranges from a largest Tilghman shot-blast room down to the ordinary tumbling barrel. The latter is provided with a silencer in the form of a wooden hood. The whole shop is provided with dust-extraction apparatus. Good use is made of

pneumatic chippers, whilst fins and riser-roughness are removed by double-ended grinders.

As a fair amount of plate moulding is practised, there is a metal patternshop adjoining the foundry, but the wood patternshop and the pattern stores are situated in another part of the works. A strict metallurgical control is established through the services of the Keighley Laboratories, Limited.



JOHN FOWLER & COMPANY—SAND-SLINGER PLANT.

An excellent start has been made in the changing over of the foundry to its new lines of production, and with the present enlightened outlook of the direction and management there is every reason to believe that, by the steady prosecution of their re-equipment plans, the present high standard of quality will be maintained under conditions of intensive quantity-production.

Hepworth & Grandage, Limited, Bradford

For all practical purposes, this exceptionally well-managed and intelligently-equipped foundry can be divided into two entirely separate manufacturing concerns having certain common services. The two sections are respectively engaged upon the manufacture of (*a*) single cast piston rings and (*b*) pistons and liners. The common services are restricted to laboratory facilities, patternshop and those of an auxiliary character.

Melting Plant

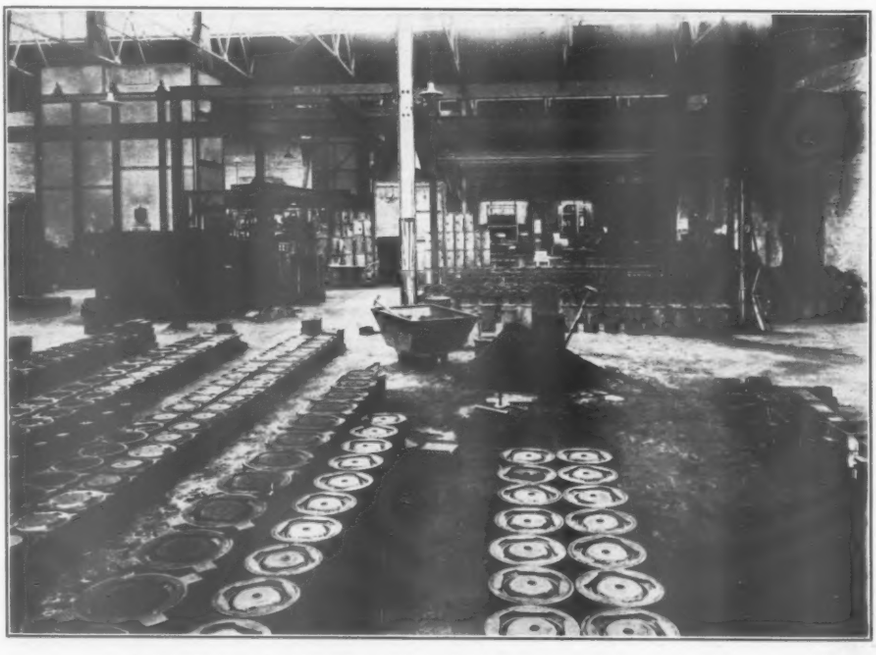
Like so many other foundries situated in the West Riding of Yorkshire, an area containing an amazing network of railways, this one is entirely serviced by motor lorry. Probably this is not such a serious factor in the present case, because the product, though running to hundreds of thousands of castings a year, is not of a heavy character. Even so, the foundry will probably be melting something of the order of 20 tons a day. Metal for the piston and liner shop is brought down in two Whiting cupolas, by Jackman of Manchester, which are designed to yield from 2¼ to 2½ tons per hr. A meticulous control is maintained as to both temperature and composition, and a wedge test is continuously in use for checking the chilling properties. The results are correlated with cupola data and filed for future reference.

No foundry attaches more care to cleanliness in production, and especially is attention devoted to ladle preparation. Every ladle is completely knocked out every night and completely relined. All ladles are of the teapot variety; the larger ones have been partially enclosed and the smaller ones are totally enclosed by sliding ganister-lined covers. Near the cupola is a proper plant for the drying and heating of the ladles and shanks. It consists of series of burners mounted at suitable heights along the wall. These burners take town's gas and utilise compressed-air injectors. This cleanliness of ladles is well worth attention by the majority of foundries in Great Britain.

Metal is conveyed to the pouring floor by means of 8-cwt. ladles running on monorails; these serve smaller tilting ladles which are operated by one man to each. The method of making these teapot ladles, which have a capacity of 8 cwts., is quite simple. A two-inch diameter stick is placed against the ganister lining at the lip, being raised about 2 in. from the bottom by a block of wood, is plastered round with ganister, and the stick is withdrawn.

Piston and Liner Foundry

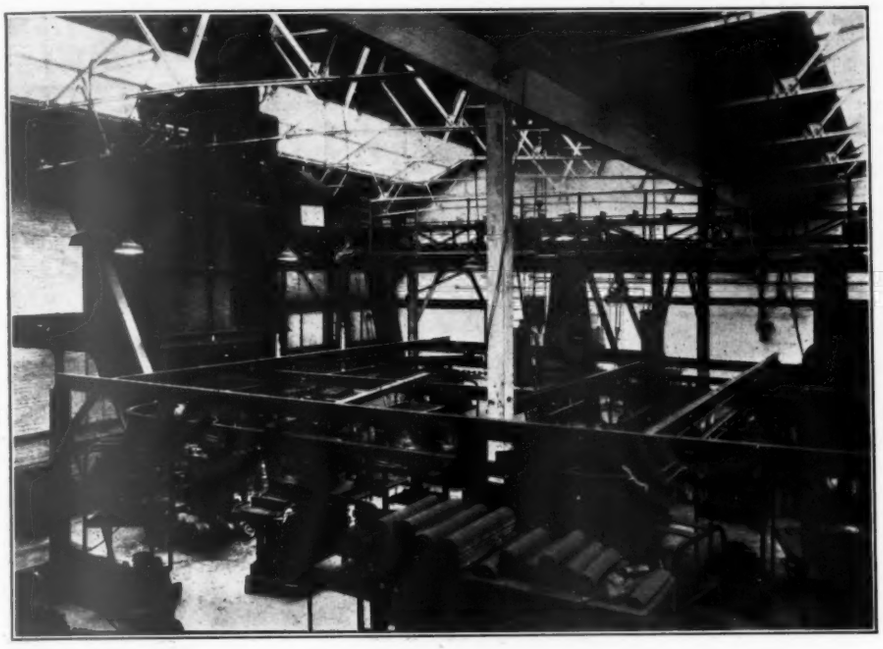
The moulding boxes are knocked-out over a V-shaped grid which is 57 ft. 6 in. long and 4 ft. 6 in. wide. The bars of the grating are spaced to give 1-in. gaps. Beneath this grating runs a 2 ft. wide belt running at 100 ft. per min. It terminates in a pulley, by Electromagnets, Limited, for taking out any tramp iron, and spills the sand into the boot of a 10-ton per hr. bucket and belt elevator. The belt, which is of rubber, carries the buckets at a 15-in. pitch. The elevator spills the sand between a pair of 14 in. diameter by 16 in. long chilled-iron rolls, for crushing any hard lumps of sand. The rolls are situated immediately above a 25-ton storage hopper. At the base of this is a rotary plate closure, and sand is ploughed off into the exterior section of the pan of a Ketin mixer. Here new Hensall sand—a local, red sand—is added, together with any other additions. Whilst this is being effected, the central portion of the mill is performing the actual duty of mixing, controlled amounts of water being added to yield for dry-sand work 8 per cent. in the sand as used. The sand from the mill, which is situated at a lower level than the moulding floor, is discharged on to a short length of something of the order of 8 ft. of 18-in. wide belt. It runs at 100 ft. per min. and elevates the sand to higher level and then spills it into the boot of a second elevator. This is made up from an 8-in. wide



HEPWORTH & GRANDAGE, LIMITED—VIEW IN THE MAIN FOUNDRY.

belt carrying buckets at 15-in. pitch and running at 180 ft. per min. This elevator feeds a 2 ft. 6 in. diameter disc type disintegrator, which discharges the sand on to a 14 in. wide push-plate conveyor running between 48-ft. centres. It travels at 60 ft. per min., and the plates are spaced at 2-ft. intervals. The conveyor feeds a number of hoppers terminating a few inches above the moulders' circular work-benches, and any overflow is returned back to the knock-out belt conveyor. On these benches the liner moulds are produced.

During the night the plant manufactures green sand containing 4 per cent. moisture for piston production, but, instead of filling the hoppers over moulding benches, the plant fills a large heat-insulated storage hopper, from which supplies are drawn during the day.



HEPWORTH & GRANDAGE, LIMITED—CORE DEPARTMENT SERVING MAIN FOUNDRY.

Core Shop

For servicing the core shop, a three-shelf pendulum type conveyor has been installed. It follows an L-shaped pathway, and is used for carrying the cores from the benches to either a standard three-stage Acme vertical continuous stove or a No. 2 Acme Junior stove, depending on the size and nature of the core. The pendulum conveyor passes close to the unloading end of the core stoves, and the empty plates are returned by it for further use by the coremakers. The core sand is prepared in a Rotoil mixer, the sea sand being dried before mixing.

Part of the moulding is by hand, but good use is made of two pneumatic machines and a squeeze machine of the Osborn, Britannia and Jackman types. The molten metal is handled by ladles suspended from monorails. Their appearance is shown in one of the illustrations.

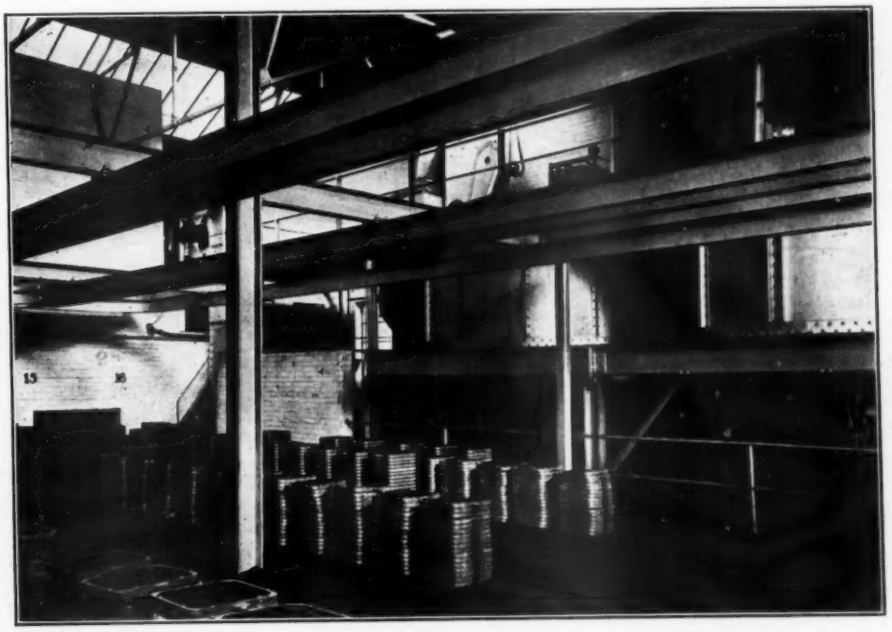
Single Ring Foundry

Metal for this foundry is supplied by a cupola of the Whiting type, but of special design. It yields 2 to 2½ tons per hr. Metal is received at the cupola in 100-lb. capacity tilting ladles fitted with sliding insulated covers, there being one man to each ladle. The ladle is suspended from a system of monorails, by a rack and pinion gear, and it is a simple matter for the man to adjust the height of the ladle and pour the moulds at the same time. Most foundries rely on a pulley-block system which demands the attention of two men, and has very little to recommend it over the use of double-handed shanks.

The general layout of this foundry is unique. Along the end wall of the foundry are eight British Insulated Cable electric moulding machines. After allowing sufficient working space in front of the machines, a wall has been constructed to keep this situation free from dust and grime. It is impossible to over-emphasise the pains taken in this foundry to keep the production free from extraneous dirt contamination. Running at right angles from each machine are three sets of rails, the outer ones being served by the monorail pouring system, whilst the central pair takes care of the incoming empty boxes. These arrive and depart through holes in the wall.

The casting bay is of impressive dimensions, as the sand handling is fully automatic and the moulds are made at high speed. The casting floor is bounded on its side opposite the moulding end by a further wall, fulfilling the same purpose as the former one, namely, that of cleanliness. It divides the casting floor from the knocking-out department. This section is 62 ft. long by 15 ft. wide, and again the moulding boxes enter it through holes in the walls. The floor of the knock-out section is one long grid, 5 ft. wide. The boxes are handled by cranes which carry a special attachment for pressing on the central runner. The castings are moulded in a tier of seventeen boxes, up to eight castings to the box, depending on the diameter of the rings. The boxes are somewhat unusual, as they are made as aluminium die-castings, and as such the fitting is perfect. The stripping of the castings from the central runner is somewhat spectacular, for the tree is suspended over a container and the operator merely makes four downward strokes to effect the separation.

HEPWORTH & GRANDAGE, LIMITED—POURING SINGLE PISTON RING CASTINGS.



HEPWORTH & GRANDAGE, LIMITED—SAND STORAGE HOPPERS IN SINGLE RING FOUNDRY.

Sand Preparation

Beneath the knock-out grating there is a 24 in. wide belt running at 100 ft. per min., which carries the sand past a Boxmag overband magnetic separator and spills it into the boot of a belt and bucket elevator. This belt, which is furnished with 12 in. wide buckets spaced at 15-in. intervals, and runs at 180 ft. per min., throws the sand into a 6 ft. 6 in. long hexagonal rotary screen of ¼-in. mesh. From it the screened sand falls on to a 24 in. flat belt conveyor running between 38-ft. centres, which discharges its load into either of two 50-ton cylindrical storage hoppers. These hoppers are furnished with rotary-table discharges, and from these the sand is ploughed off on to an 18 in. wide flat belt conveyor running between 22-ft. 6-in. centres. This spills the sand into a second elevator, which fills a 1-ton capacity measuring hopper situated immediately above a No. 3 August Simpson intensive sand mixer equipped with a water meter. New sand is added by the bucket loader and the mixed sand passes through the disintegrator, built integrally with the mill, and feeds a hopper having a rotary table discharge. From it, the sand is ploughed off into the boot of a third elevator which feeds a push-plate conveyor riding in an 18-in. trough. This conveyor and many other components have been furnished by Morris, of Loughborough. As is now usual, a number of the plates are serrated. Being a batch system of manufacture and distribution, there is no need to provide for taking care of surplus production should the mould hoppers, of which there are eight, be over-filled. The preference for this batch system is obvious when related to the control, for each batch of sand is tested for moisture and A.F.A. bond, whilst permeability tests are carried out on every four mixings.

The control established in this foundry is of a particularly high standard, and whilst production is reasonably continuous, the insistence on the batch principle does effect a complete correlation between metal and sand, the two major factors involved. It provides a subject well worth studying by the majority of foundries.

Fettling Shop

An interesting feature of the fettling shop is a recently installed Luke & Spencer double-ended grinder taking 20-in. dia. by 2½-in. face Borolite wheels. The machine has a fan built into the casing and its bag filter makes it into a complete unit. It is furnished with a speed-changing gear so that the correct peripheral speed is maintained throughout the life of the wheel. In the circumstances existing at the Hepworth & Grandage works, where the metal to be removed is more or less "flash," it has made a saving of 40 per cent. on grinding costs.

Hopkinsons, Limited, Huddersfield

The manufacture of valves and boiler mountings in two adjacent cottages in Huddersfield marked the beginning, in 1843, of the activities of Hopkinsons, Limited. Work was carried on in a larger factory from 1871 up to 1904, when the present Britannia Works were opened. These works, subsequently enlarged on several occasions, occupy a ground area of 18 acres, and are equipped for dealing with every process in valve manufacture, including metallurgical and foundry work.

Hopkinsons' products are known all over the world, and have, from the first, played a leading part in steam-generating practice, while their widespread use may be gauged by the fact that practically every electrical power station in Great Britain is equipped with this firm's valves.

During recent years the sharp upward trend of boiler working pressures has necessitated the manufacture of large numbers of valves and mountings for working pressures above 600 lbs. per sq. in. and working temperatures above 800 deg. Fah. During the present year, orders have been completed for valves up to 2,130 lbs. per sq. in. working pressure, and 932 deg. Fah. working temperature. In view of these exceptionally severe conditions, it will be realised that all castings must be of the highest quality, and the following notes regarding Hopkinsons' foundries will therefore be of special interest.

STEEL FOUNDRY ORGANISATION

Transport and Handling of Raw Material

Pig-iron.—This material is received at the L.M.S. sidings, and is transported by road to Britannia Works, where it is stacked in a yard adjacent to the melting plant.

Scrap.—The only scrap used is that produced by the removal of runners and heads by the fettling shop. After these have been removed, they are returned to the melting plant and re-used in predetermined proportions.

Coke is used for the Pneulec and Augusts mould-drying stoves, and also for the Augusts core-drying stoves, and is delivered by road, being stored adjacent to the respective fireboxes.

Sand is transported from the L.M.S. sidings and is stored in two locations, one near the core-sand mixing machines, and the other near the moulding-sand plant. A description of the sand plant employed is given later.

Melting Plant

The melting plant consists of a Stock converter with a nominal capacity of 2 tons. The capacity has been increased and the plant is now melting a maximum weight of about 3½ tons. Oil is employed as the heating medium, and the air blast is provided by a Roots blower located close to the converter. The air is preheated by being passed through a series of C.S. pipes situated behind the converter.

Handling Molten Metal

The molten metal is delivered from the converter directly into ladles, of the bottom-pouring type, which are carried to the casting floor by a 15-ton electric three-motor travelling crane. After the moulds have been cast, they are placed on a transfer truck, which is run directly to the knock-out and sand preparation department.

HOPKINSONS, LIMITED—GENERAL VIEW OF THE STEEL FOUNDRY.

Sand Preparation

When the recently cast moulds are received in this department, they are removed from the transfer truck, and empty moulding boxes from a previous heat placed on the truck, which is then returned to the moulding department.

The moulds are placed on the knock-out grating which is 10 ft. square and has 1¼ in. openings. Here all sand which is obviously not burnt is freed from the mould and passed through the grid which surmounts a hopper feeding a 5 ft. diameter rotating table. From this, it is ploughed off to feed the boot of a 10-ton per hr. belt and bucket elevator. The buckets, which are about 10 ins. wide by 6 ins. deep, deliver the sand to a 2 ft. 4 in. wide magnetic belt running between 8 ft. centres. Then the iron-free sand enters a rotary sieve having a ½-in. mesh, the overmatter dropping down a shute to fill a portable container. The sieved sand falls into an 8-ton capacity hopper. The feature to be noted at this point is that the underlying principle is the preparation of two distinct types of sand—facing and backing. If the former is being prepared, the closure, which consists of a moving belt, is automatically controlled to deliver a definite quantity of sand to a three roller mill. To this is added the necessary new sand and water which is measured through a water meter. The mill automatically discharges each batch made into the boot of a second belt and bucket elevator to fill a 10-ton storage hopper. At the opening of this there is a special disintegrator of the horizontal type. It is rubber lined and carries a rotating plate

to which ¾ in. prongs are attached. It takes only ten minutes to change the prongs.

When backing sand is being prepared, there is a continuous stream of sand from the 8-ton storage hopper into the mill, the gate of which is left partially open. The second elevator takes this sand up a height to fill a second storage hopper of 15 tons capacity placed at the side of the facing sand hopper. The hopper is provided with a trap door, operated by a ratchet and pinion system to fill ¾-ton capacity roller-bearing-wheeled tubs running along a gallery extending the full length of the moulding shop. It is then delivered as required to bins adjacent to the moulding machines and hand moulders.

At the side of the main knock-out is a second grating, and either by the crane or by hand the roughly knocked-out castings are transferred. Here the burnt sand is removed and falls through the grating into a hopper. This hopper has a rotary table closure and the sand is ploughed off into the boot of a belt and bucket elevator to fill a hopper situated outside the foundry building. This waste material fills by gravity, and motor lorries are used for its final removal.

This plant, which was designed and manufactured by Pittevil & Company, has for its object the preparation of two types of controlled sand, their economic distribution and the rational evacuation of burnt sand.

Core sand is produced in a department distinct from the moulding-sand plant, and provided with a town's-gas sand-drying plant and two Smedley sand mills. The core sand is then delivered to the core-making department by means of a bucket elevator.

Moulding Plant

A large proportion of the work is done on moulding machines, using plate patterns. The majority of the machines are of Macdonald manufacture, but machines of Jackman and Zimmermann type are also in use. These machines are all pneumatically operated, being supplied with compressed air at 90 lbs. per sq. in. pressure.

Foundry Buildings

The foundry and its various departments occupy approximately 6,500 sq. yds. and consist of four bays, namely: (*a*) moulding bay; (*b*) knock-out, sand conditioning and fettling; (*c*) hydraulic testing—inspection and cold sawing; and (*d*) sand-blasting, annealing. The buildings are of brick construction with steel truss roofs, with patent glazing, and all bays are served by suitable electric travelling cranes.

The foundry is efficiently lighted by means of gas-filled lamps and reflector-type fittings. Electric motor fans are provided in the gables for the ventilation of the bays, and portions of the roof glazing are arranged to open.

Fettling Department

Fettling is done by means of pneumatic chipping tools and grinders. Several "Hycycle" grinders are also employed. Cold saws, together with oxy-acetylene flame torches, are utilised for the removal of heads and runners. Oxygen is purchased in liquid form and is evaporated and delivered in pipes to the various points of use. Acetylene is also produced in bulk.

There are six pneumatic shot-blast rooms for cleaning the castings, supplemented by a Tilghman Wheelabrator. Annealing is carried out in two Priest gas-fired regenerating annealing ovens.

Core Shop

The cores are made in a room above the main foundry level, and are dried by means of four Augusts coke-fired stoves. The cores are stacked on racks and are pushed into the stoves on elevating trucks. After drying and inspection the cores are placed in containers, and delivered to the required positions by means of the foundry travelling cranes.

Patternshop

The patternshop is provided with modern equipment, including surfacing and thicknessing machines, saws, sanding machines and a Wadkin core-box milling machine. Metal patterns are also produced in this department. The storage arrangements are extensive and are situated behind the main pattern shop, and are under this department's control.

Chemical and Physical Control

All metal and castings produced are under the control of an efficient and modernly equipped chemical and physical laboratory. The physical laboratory is provided with a 30-ton Buckton testing machine, Izod machine, creep testing apparatus, Brinell machines, electrical crack detectors, and friction machines. Tests are made on each heat melted, ensuring a constant quality of production.

"Hipress" and "Hytemp" Cast Steel

For standard cast steel bodies and covers suitable for working temperatures up to 800 deg. Fah., "Hipress" cast steel is the material in use. This is a straight carbon steel possessing the following physical properties:—Maximum stress, 28 to 32 tons per sq. in.; yield, 14 to 16 tons per sq. in.; elongation in 2 in., 25 per cent.; reduction of area, 40 per cent.; bend test, 160 deg. without fracture on 1-in. radius.

As previously mentioned, the manufacture of large quantities of valves for working temperatures above 800 deg. Fah. has been an important development during recent years, and the wide extension of the firm's knowledge and experience of the effect of high temperatures upon the physical properties of cast and forged steels has resulted in the production of "Hytemp" cast steel for valve bodies and covers for temperatures above 800 deg. Fah. The physical properties of this material are:—Maximum stress, 30 to 36 tons per sq. in.; yield, 15 to 18 tons per sq. in.; elongation in 2 in., 25 per cent.; reduction of area, 40 per cent.; bend test, 160 deg. without fracture on 1 in. radius.

WELFARE

A modern and comfortable canteen is provided capable of seating approximately 800 persons, and a good variety of meals can be obtained at reasonable prices. Washing accommodation is available for all employees, while shower baths may be used if desired. All minor injuries are treated in a well-equipped ambulance room, which is under the control of a qualified attendant.

A sports and social organisation is in operation, and extensive playing fields are available for various outdoor sports, while various indoor activities are organised.

NON-FERROUS FOUNDRY ORGANISATION

Handling of Raw Materials.—All virgin metals are conveyed by road transport to the works and delivered direct to the foundry metal stores, where the mixings are carefully weighed out and despatched in boxes by elevator truck to the furnaces.

HOPKINSONS, LIMITED—STEEL FOUNDRY FETTLING SHOP.

Melting Plant.—The melting plant consists of two high-frequency electric induction furnaces of ¼-ton capacity; a 200-lb. arc furnace; two oil-fired reverberatory furnaces; a Morgan gas-fired crucible tilting furnace; and two gas-fired pit furnaces.

Handling Molten Metal.—The liquid metal is poured from the furnaces into hand-shank ladles and taken to the skimming hole for skimming and temperature recording, which is under pyrometric control.

Moulding Plant.—The foundry is equipped with modern moulding machines, which include ten power and seven of the squeeze and draw type.

Chemical and Physical Control.—All alloys are melted under accurate physical and chemical control. Tests are taken from each heat and sent to the laboratories and physical test house, the equipment of which has already been noted.

Among the special metals produced by the non-ferrous foundry, mention may be made of the "Platnam" alloy, which is made in several grades according to pressure and temperature requirements. "Platnam" is Hopkinsons' standard material for valve faces and seats, and its relatively low coefficient of friction, great hardness, high non-corrosive and stability characteristics render it specially suitable for these duties.

Modern Foundries, Limited, Halifax

Historical

This foundry, which was opened in 1931, is a subsidiary of William Asquith, Limited, the well-known manufacturers of machine tools. The parent company was founded in 1865, in what was then the remote village of Highroad Well. At the outset, like all similar establishments of those days, the firm was concerned with the manufacture of a multiplicity of machine tools, and during the first few decades the manufacturing policy embraced many types of lathes, planing machines, shapers, slotters, drilling and boring machines of all types, etc. Even in those days the name of Asquith was noted for the quality and high-class workmanship of its products, and the firm numbered amongst its principal customers many of the largest engineering concerns both in this country and abroad.

Following the death of the founder in 1901, the firm was carried on by the late J. H. and J. W. S. Asquith, who, in 1903, decided that it would be advantageous both to the firm and customers to concentrate on the manufacture of definite classes of machines, to include radial, vertical and horizontal drilling machines and heavy-duty boring and milling machines up to the largest diameter spindles. This policy, which was maintained upon the formation of the present company, proved highly successful, and William Asquith, Limited, became esteemed in the sphere of drilling-machine design and manufacture.

Present-day manufactures include radial drilling machines from light sensitive models to machines of 13 ft. radius for drilling up to 5 in. from the solid; horizontal boring and milling machines from 1½ in. to 12 in. diameter spindles; vertical drilling machines in a wide range of sizes; keyway-cutting machines; portable universal radial drilling machines; heavy-duty drilling machines for armour plate and similar classes of work, and a variety of machines for the aircraft and automobile industries, including cylinder boring machines, honing machines, unit head type machines for various duties, aeroplane wing spar drilling machines, taper hole boring machines for propellers, and profile milling machines. The last named have achieved distinct popularity, and no fewer than 160 of these models have been supplied within the past few months to the leading aircraft factories. Special attention is also directed to the requirements of the shipbuilding and railway industries.

The works, which are amongst the largest of their kind in the world, cover a site of 12 acres, and have been constructed and developed on the most modern lines, plant and methods being carefully organised in such a way as to ensure economical and rapid production and provide the utmost facility for coping with the extensive manufacturing schedule.

The foundry, operated under the name of Modern Foundries, Limited, is quite near to the parent works, and it surely must rank amongst the highest foundries in Great Britain. It is some 800 ft. above sea-level and situated on the slope of a hill. Advantage is taken of this fact to place the cupola and furnace platform at the same level as the stock yards, and so reduce the cost of handling. This is an important item, as there is no railway in the vicinity and all material entering and leaving the foundry does so by motor transport. The stock yard is neatly laid out in well-defined areas, and each brand of iron is indicated by a tally attached to a post.

MODERN FOUNDRIES—BRACKELSBERG MELTING FURNACE.

Melting Plant

The melting plant is modern and unique in conception and layout, and consists of two 15-ton Brackelsberg rotary pulverised-fuel-fired furnaces, two 5-ton per hour Whiting cupolas and a 15-cwt. Roper cupola. The operation of this foundry was dealt with in a very comprehensive Paper read last week before the annual conference of the Institute of British Foundrymen, and this article can be regarded more especially as dealing with layout and plant.

The Brackelsberg plant includes its own grinding equipment, which has been designed by the British Rema Manufacturing Company, Limited, an associated company specialising in pulverising plant and now occupying premises previously housing the foundry department of Wm. Asquith before the creation of Modern Foundries. Actually, two types of pulverisers are used—the ring and high-speed mills—and thus a good deal of specialised information has been amassed as to their respective performances for furnace work. The small cupola has been installed for the purpose of making relatively small quantities of alloyed cast iron. The provision of this type of casting is assuming important proportions in the output of the foundry, the total of which is of the order of 70 tons a week. The cupola is lined with bull-head bricks of Scottish make. This, according to Mr. Blakiston, has induced an economy of 20 per cent. This is very interesting, because for years it was assumed by foundrymen that the joints in brickwork created the source of weakness. Yet these bull-head bricks introduce double the number of vertical joints. Offset against this, however, is that this type of brick is machine-pressed and the "business" face receives the full benefit of the pressure. The wider bricks are, generally speaking, hand-made and therefore less dense.

MODERN FOUNDRIES—GENERAL VIEW OF ONE OF THE HEAVY MOULD BAYS.

Special Pig-Iron

The output of the melting plant is in excess of the foundry's requirements, and thus immediately in front of the Brackelsberg furnaces is a pig bed. Not only is pig-iron of any desired commercial specification made for remelting in their own cupola plant, but a wide connection has been established with other foundries.

The foundry is made up of four 45-ft. wide bays, and to serve the various sections ladles are placed on trucks running on rails set transversely across the shop. Each bay is served by two cranes of 20 tons with 5 tons auxiliary lifting capacity. Handling facilities are augmented by a number of wall and pillar jib cranes, some of which are electrified.

Sand Preparation

The sloping site is also utilised for the economic handling of sand, and the bins are situated at a level lower than the outside roadway. A modern 6 ft. diameter August-Simpson mill of the bucket-loading type prepares the various grades of sands utilised. Sand distribution is effected by means of boxes mounted on bogies, suitable for handling by the overhead cranes. There are six mould and core stoves, which are coke-fired, using forced draft. They have a total surface area of 2,400 sq. ft.

The end of the foundry opposite to the melting plant is in part occupied by the fettling shop, and between the two is a well-kept transverse road. At the foundry side of this is an area reserved for the storing of the portable mould-drying stoves.

As would be expected for a machine-tool foundry, the fettling shop is particularly well equipped with pneumatic chippers and the like, but what is probably the most interesting feature in this section is the disposal of old sand. This is fed into a hopper where a 12-in. belt running between 40 ft. centres takes it up a height, passes it over a magnetic pulley for metal extraction, riddles it for the extraction of coke used for venting purposes, and discharges the dirt by a shute outside the foundry into a container for removal by lorry.

This foundry, apart from producing castings for the parent company, has an excess capacity which it utilises for supplying the trade generally with the higher grade of castings, especially those designed to meet the requirements set out in the recently-published B.S. Specification for high-duty castings.

Another feature of this foundry is the provision of special machinery made by the British Rema Manufacturing Company for mixing of the blacking. This machine, which is electrically-driven, ensures that whenever demanded by the moulder, an intimate mixture is available.

Prince-Smith & Stells, Limited, Keighley

This company was formed in 1931 to acquire the two old-established textile machinery firms of Prince-Smith & Son, Limited, and Halls & Stells, Limited, both of Keighley. The former was founded in 1795 and the latter in 1865. The founders of Hall & Stells, Limited, were previously employed by Prince-Smith & Son, Limited, so amalgamation brought together two firms which had started as one and subsequently separated.

Thus, although the name of Prince-Smith & Stells, Limited, is comparatively new, the history of the concern dates back to the earliest days of the industrial era. The family tradition behind the business has been maintained, the present chairman of the company being the great-great-grandson of the original founder, and the vice-chairman a son of the founder and senior partner of Hall & Stells, Limited.

Prince-Smith & Stells, Limited, is the only company in the world manufacturing complete plant for the worsted combing and spinning industries on both English and French systems, and has recently placed on the market a patented system of preparation known as the "Anglo-Continental," which combines many features of both English and French systems.

The works are well served by the present foundry, which covers some 11,000 sq. yds. and was completed in 1913. Contrary to what might be expected, the castings demanded of the foundry are of a comparatively light section. Light castings are also supplied in large quantities to the general engineering trade. Thus, no loam moulding is practised, nor indeed is it necessary.

The Foundry

The construction of this foundry is unique, and in shape resembles that of an open fan, having the melting plant situated at the centre point. From it, radiating in every direction, are well-surfaced clear roads for the distribution of metal. Moreover, these roads are intersected by auxiliary ones, running at right-angles.

A second feature seldom encountered is that the company's private railway sidings are at the cupola charging level, and the major part of the raw materials, pig-iron, scrap and coke, are stored under cover, whilst sand is tipped down a shute into the sand preparation department. Before using, the pig-iron is broken in a pig-breaking machine. Scrap from the foundry, consisting mainly of runners and risers, is brought up by a push-button controlled electric hoist.

The cupolas, which carry a number of auxiliary tuyeres for burning any carbon monoxide formed to carbon dioxide, are solid bottomed and are blown by Roots blowers. There are three altogether, two of 8 tons per hr., and one of 4 tons, the last one being used on Saturdays or periods of recession. One bay is fed with metal by an overhead monorail system, but, in general, reliance is placed on hand-shanking from the wheeled bogies. There is quite a nice layout for the drying of these ladles, using coke as fuel.

Moulding Methods

Altogether there must be close on a hundred moulding machines installed, many of which are plain stripping machines, but in addition a number of the floors are laid out with special moulding boxes for plate moulding. This system, where it can be adopted, represents a very intelligent form of mechanisation, for the only movements are those of the moulder carrying his pattern from one box to the next. If there be a drawback at all, which we doubt, it is that the control of the sand is effected at each station by empirical means, usually the great experience of the operator. The design of these textile castings is such that comparatively little coring is necessary, and the core shop is surprisingly small for such a large foundry. The fettling shop, too, from the same cause, is of quite small proportions. Much of the work lends itself admirably to cleaning by the rotary shot-blast table, and there is a modern installation by Gutmann, furnished by Fearnley Allen, of Birmingham.

Additionally, there are a shot-blast chamber and a number of grinding machines, all of which are freed from dust by plant installed by Spencer & Halstead, of Otley.

At the side of the foundry, but housed in a separate building, is the pattern stores. This is a two-storied building, communication with the first floor being made by electric lift. A sprinkler system has been installed in case of fire. It is doubtful whether any firm in the kingdom houses so many patterns, and a modest estimate of the number stored would be of the order of three-quarters of a million. The system is such that the foundry foreman can rely on getting any pattern he asks for in the space of a few minutes.

PRINCE-SMITH & STELLS—THE FOUNDRY LOOKING TOWARDS THE FETTLING END.

A strict metallurgical control is imposed on the conduct of the foundry through the offices of Keighley Laboratories, Limited—a co-operative organisation in which most of the local foundries participate.

An excellent welfare department has been established, and adjoining the foundry is the sports field. The cups displayed in the entrance to the main office are an indication that recently the works teams have been very successful.

The Randupson Process of Cement Moulding*

By F. W. ROWE, B.Sc.†

The Randupson process of cement moulding is the invention of a French engineer, Mr. Durand, of the Cie Randupson, of Marseilles, and has been developed, particularly with regard to the special technique necessary, by the Société d'Electro Chimie d'Electro-Metallurgie et des Aciéries Electriques d'Ugine (who own the world rights) at Ugine in the South of France, during the past seven years.

It consists, briefly, of the use of silica sands bonded with ordinary Portland cement and water in place of the more usual moulding sands. This sand-cement-water mixture is rammed round patterns mounted in wooden box parts or in coreboxes or strickled in the manner usual with loam sands. The sand is reinforced at various points with straight irons, and staples are embedded where necessary for lifting. The resulting moulds or cores are set aside to harden, for periods varying from 24 to 48 hrs., blacked if necessary, then the various parts clamped together and cast without any surrounding box parts.

The moulds or cores after they are set have great mechanical strength and very high permeability. After casting the moulds are stripped in the usual manner and the sand crushed, desilted and stored for use over again.

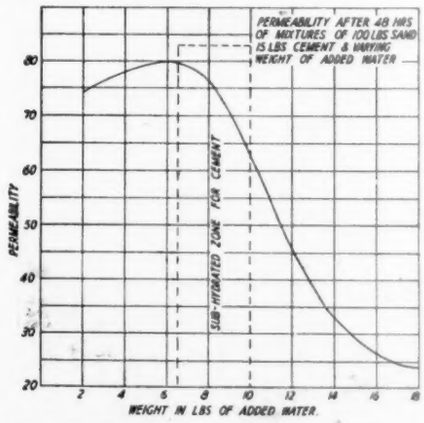

PERMEABILITY AFTER 48 HRS OF MIXTURES OF 100 LBS SAND 15 LBS CEMENT & VARYING WEIGHT OF ADDED WATER
PERMEABILITY
SUB-HYDRATED ZONE FOR CEMENT
WEIGHT IN LBS OF ADDED WATER.

FIG. 1.—PERMEABILITY CURVE FOR 15 PER CENT. CEMENT.

Sand bonded with cement for foundry use appears to have been tried as early as 1897, and Moldenke makes mention, in his well-known text book, of cores made from a cement-bonded sand, but the use of such sands for cores appears to have been abandoned after an experimental period. This is understandable, since no study of the fundamentals appears to have been made and the sole object of the addition of the cement was to provide a bond.

Mr. Durand, however, in his researches discovered that it is essential to preserve a certain well-defined ratio between the amount of water used and the quantity of cement, to ensure the high permeability which is the outstanding feature of the process. Normal recognised methods of permeability testing are of little value for Randupson mixtures, since the permeability is much higher than that obtained with other types of moulding sands.

Rôle of Water Additions to Cement

In order to ensure this high and essential permeability, the proportion of water added to the cement sand mixture must be such that the cement is subhydrated only. Given an unlimited amount of water, Portland cement absorbs water in two stages. The first absorption takes place usually inside 24 hrs., and is called the first set, whilst the second absorption proceeds more slowly and is not complete for a period approaching 28 days.

It is the first set only with which the Randupson process is concerned, and provided the essential conditions of the specifications are observed, the permeability of the mixture when set and fully hardened is extremely high. Fig. 1 shows a typical permeability curve for a mixture containing 15 per cent. of cement with varying proportions of added water, and illustrates the importance of subhydration only. It will be seen that once the correct proportion of water is exceeded, the permeability drops with extreme rapidity, and such material would be useless for foundry work.

In practice the actual proportion of cement and water used depends very largely on the type of casting being cast. At the present time large tonnages of carbon and alloy steels, cast iron, gunmetal, phosphor bronze and manganese bronze, aluminium alloys and magnesium alloys are being cast by this process and in weights varying from a few pounds up to 30 or 40 tons, and so experience has shown what variations are needed to get the best out of the process for varying conditions.

Sand Considerations

The type of sand used is dependent on commercial considerations and local deposits, but the most suitable is a fairly pure silica sand of rather coarse grain size—for instance, one in which 70 per cent. of the grains remain on a 60's sieve. Reasonable freedom from clay and fine silt is an advantage for the Randupson process, and where refractoriness is important, as in the case of steel castings, a 98.5 per cent. pure silica should be aimed for. For cast iron and lower melting-point alloys this is not so important, and a less degree of purity can be allowed providing the correct grain size and low clay content is secured.

Cement proportions most suitable for various conditions vary from 3 to 15 per cent. with a total water content in the mixture from 2 to 9 per cent. The actual mixing is usually done in a mill where no milling occurs, and most of the more modern types of mills are suitable for Randupson sands. The mixing time is very short—the total cycle is usually between 1½ and 2½ min. The sand must be used within three to five hours of being mixed, and any sand remaining unused has to be returned to the mixing plant for reconditioning.

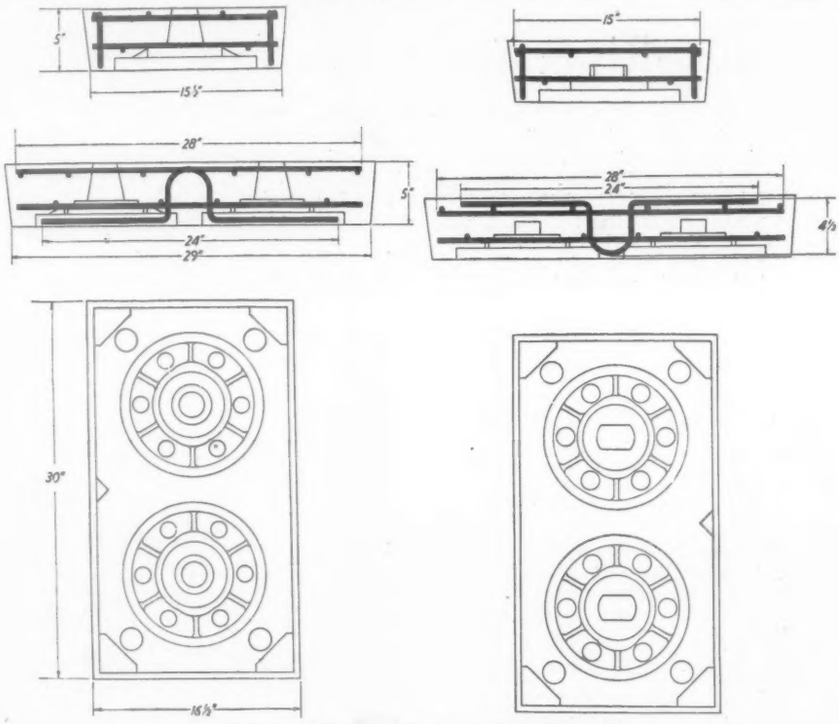


FIG. 2.—TYPICAL INSTRUCTION CHART FOR RANDUPSON MOULDING (FOR 8-IN. WORM WHEEL CENTRE).

The uppermost diagrams show the position of the irons (15 in. by ⅜ in. round) and patterns. There are ten irons in each mould. The central diagrams show the position of the irons and staples (4½ in. by 24 in. by ⅜ in. round, two in each mould; irons 28 in. by ⅜ in. round, six in each mould). The lowest diagrams show the position of the patterns and the two runners and risers in each mould.

Steel Foundry Conditions

For iron and non-ferrous founding it is usual to use nothing but old sand, but for steel founding a facing of all-new sand is essential to secure the highest refractory properties. In the green state the sand has very little bond and in this respect is comparable to sea sand bonded with oil. The sand, therefore, will not "lift" and suitable arrangements to cater with this are necessary in setting out a job for moulding. Split patterns are the ideal or the "all core" method, but with very little ingenuity most existing patterns or methods for moulding can be adapted with very little expense.

Mould Making

Ramming is very easy and needs little skill; in fact, this is the main advantage of the pro-

* Paper read at the Annual Conference of the Institute of British Foundrymen at Bradford last week.

† David Brown & Sons (Huddersfield), Limited.

cess. The sand flows readily and needs little compression and it is remarkable with what speed the wooden core or moulding boxes are rammed. The sand can also be jolted or vibrated with equally successful results. It is necessary in all but the smallest cores and moulds to reinforce the sand with straight rods of iron. Suitable stocks are kept of straight irons of varying diameter and length, and these are embedded in the mould during the process of ramming. If it is necessary for the mould or core to be afterwards lifted by the crane, suitable staples are embedded also. The mould is usually turned over on to a wooden board and the pattern and wooden frame removed.

FIG. 3.—SHOWING METHOD OF CLAMPING ONE TYPE OF MOULD.

In the case of large moulds, *i.e.*, those above 4 ft. square, a steel plate of welded construction is used, since large boards have not sufficient stiffness to remain flat when being slung by the crane. The mould (or core), after the necessary finishing, is put on one side for the chemical reaction of setting and hardening to take place. How long this takes depends entirely on the composition of the mixture, the temperature conditions of the shop and the size of the mould. In most cases it is advisable to allow 48 hrs. for this to take place, especially if the average temperature of the foundry is between 45 and 55 deg. Fah., but if the shop temperature averages 60 deg. Fah., small and medium-size moulds are sufficiently set to be safe to cast or to black in 36 hrs. In most cases, however, even the largest moulds and cores are sufficiently strong to lift in 24 hrs.

In the case of steel moulds no coating of the moulds is necessary or even desirable, and the same applies to non-ferrous alloys (including aluminium alloys) except those containing phosphorus or those of which the casting temperature exceeds 1,150 deg. C. For cast iron, owing to the fluidity of the metal, a coating of blacking is necessary, and this is best done when the mould or core is set. Sufficient time is allowed for this blacking to air-dry, usually six to twelve hours, or the blacking can be dried with a blow-lamp or hot-air dryer in a few minutes.

The moulds are clamped together in the manner shown in the various illustrations and cast in the normal way. It is a little frightening to foundrymen to see large moulds being cast without enclosure of any kind, but experience soon breeds confidence, and after one has seen a few 20-ton rolls, 15 ft. long, cast in an open pit one soon begins to appreciate the extraordinary mechanical strength of the Randupson mould.

After the moulds have been cast, they are knocked out either on a grid or in proximity to a crusher. The used sand passes through a crusher and is elevated to screens or other type of desilting plant which removes the larger portion of the spent cement and any silt, and stores the reconditioned sand in hoppers over or adjacent to the sand mixer. This reconditioned sand is mixed with the correct proportion of cement and water, and used over and over again. In iron and bronze founding no new sand is needed except to replace that lost by inevitable wastage, but, as mentioned previously, a layer of all-new sand should surround the pattern or form the outside of the core in steel founding. To economise in sand it is usual in large moulds and cores to form the greater portion of these

FIG. 4.—LARGE ROLL CASTING MOULD AFTER BEING CAST.

FIG. 5.—SAME MOULD AS SHOWN IN FIG. 4 PARTLY STRIPPED.

FIG. 6.—CASTING STRIPPED FROM MOULD.

FIG. 7.—RACK STORAGE OF MOULDS.

from lumps of old broken moulds. These replace the usual coke filling in large cores also.

Core construction is exactly similar to that employed in ordinary moulding, except that in no circumstances are cast grids necessary, and the vent wire is never used (nor is this ever used in moulding). On acount of the high strength of cores it might be thought that with thin castings contraction troubles might be experienced, but provided the sand wall does not exceed 2 to 3 in., such do not occur. The reason for this is obvious on studying the mechanism of the casting. Cement, like any other hydraulically-bonded material, breaks down under the application of heat, and thus the $\frac{1}{4}$ or $\frac{1}{2}$ or 1 in. of sand adjacent to the casting (dependent on the mass) is rotted under the action of the heat of the metal, allowing the casting to contract and rendering dressing operations easy. Fettling or dressing costs on castings made by the Randupson process are no different from, and certainly no more expensive than, normal methods.

FIG. 8.—TYPICAL SECTION OF LARGE MOULD FOR CAST IRON TURNED OUT ON STEEL PLATE.

Disadvantages of the Process

It is not irrelevant at this stage to review the disadvantages, obvious or otherwise, of the Randupson process. First of all there is the disadvantage of the time needed for setting and the space occupied by the moulds during this setting time. In practice it can be said that no mould is cast until two days after moulding, *i.e.*, moulds made on Monday are not cast until Wednesday. This excepts special cases and rush jobs which can be stove-set ready for casting in six hours if stoves are available, or moulds otherwise dried where the setting time is artificially aided by heat.

Secondly, there is the room occupied during the setting time. In most foundries the mould made on Monday is stoved on Monday night and cast on Tuesday, but with Randupson extra storage space has to be provided to store two days' moulding instead of one.

Thirdly, all sand used has to be put through the mixing plant, and all old sand has to be regenerated with fresh cement.

Fourthly, the sand will not last for more than three to five hours (dependent on shop temperature conditions and the exact mixture).

Fifthly, the cost of the sand due to all having to go through the mill and to have new cement additions each time, is more expensive than normal sands used in iron or bronze founding practice. In steel founding the sand costs on Randupson are about the same as with the old methods, or in some cases cheaper.

Sixthly, the sand will not lift and has little or no bond in the green state.

Having recited these disadvantages, the author will go into the practical significance of these as they appear in everyday practice.

Process Analysed

This first disadvantage, that of setting time, is a big one on small moulds usually cast green sand, and, in the author's opinion, considerably lessens the appeal of the process where the larger majority of the work is cast green sand. In medium-sized work normally dried, the disadvantage is not so marked, since only an extra day is required and suitable racks or storage stands can be made (as shown in Fig. 7) to hold the moulds or cores during the setting period

FIG. 9.—MOULDING SMALL AND MEDIUM STEEL CASTINGS ON CONVEYORS.

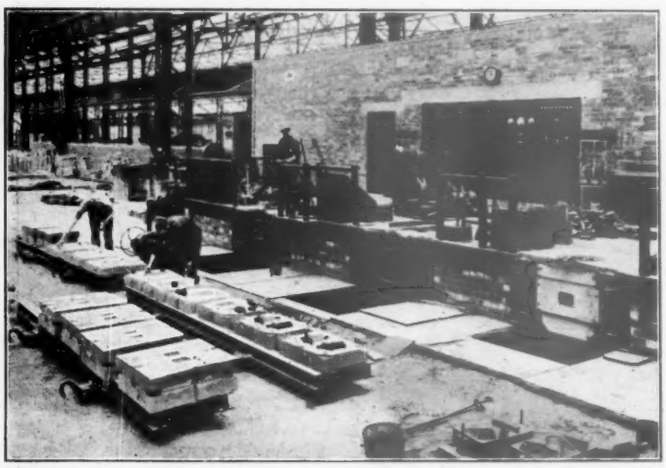


FIG. 10.—SETTING SMALL AND MEDIUM STEEL CASTINGS IN CASTING BAY.

FIG. 11.—MOULD FOR LARGE MARINE GEAR-CASE CASTING—ALL-CORE METHOD.

In large moulds the advantage is very definitely on the side of the Randupson process for the following reasons. Due to the extraordinarily speedy moulding possible with Randupson, the extra time needed before casting is more than compensated for by the saving in moulding time. This remark refers to time only, quite apart from cost considerations. As a typical example, the author will quote a casting which repeats itself in the foundries with which he is connected with fair frequency, so that they have recorded numerous time studies both in clay-bonded and Randupson sand. In skin-dried clay-bonded sand the piecework time was 120 hrs., and two skilled moulders usually make and case one of these castings in one week. With Randupson, the piecework time is 45 hrs., and one skilled man and three helpers make the mould in one day. Thus, in the old method a mould started on Monday is cast last thing on Friday, whereas a mould in Randupson is started on Monday and finished that day and cast on Wednesday, a saving of two days.

If a number off a large mould is required from the same pattern, the saving in time is much more remarkable. For instance, if the same pattern came in for six off, in the ordinary methods

FIG. 12.—SETTING MOULD FOR MANGANESE-STEEL PELTON WHEEL CASTING.

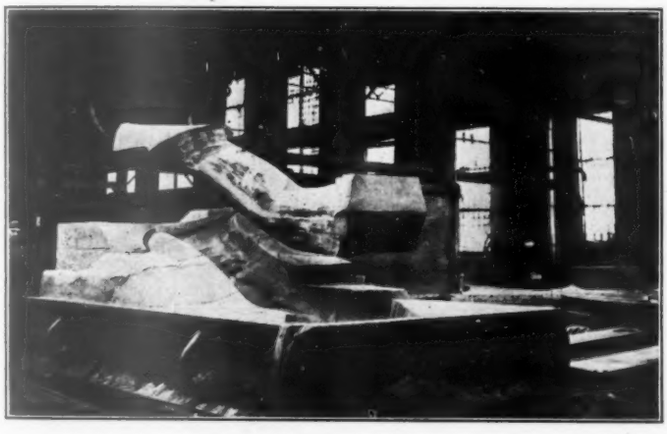


FIG. 14.—CORING CEMENT MOULD FOR CAST STEEL HAWSE PIPE.

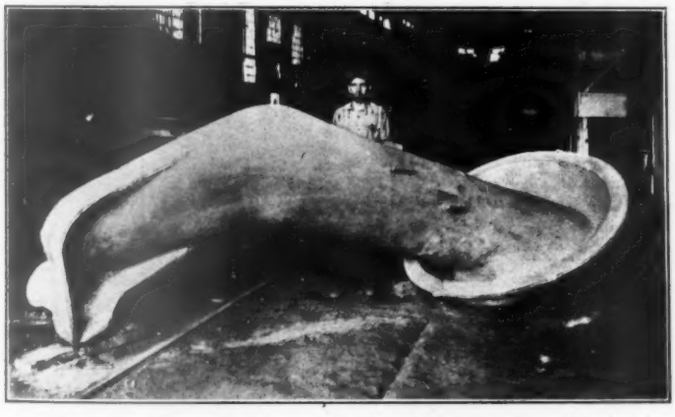


FIG. 16.—FINISHED CASTING FROM THE MOULD SHOWN IN FIG. 15.

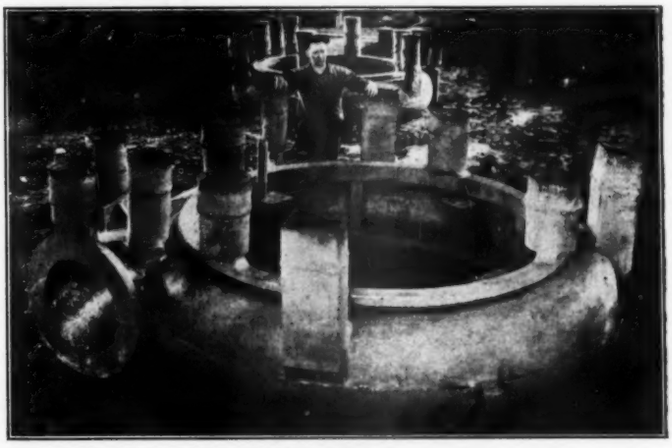


FIG. 13.—LARGE WATER-TURBINE CASING IN CAST STEEL.

FIG. 15.—MOULD READY FOR CLAMPING BEFORE CASTING.

FIG. 17.—VIEW OF FOUNDRY SHOWING TYPICAL SMALL AND MEDIUM MOULDS.

six weeks would be required, whereas in Randupson six castings could be made in nine days.

In brief, it may be said that in large complicated castings, where the normal moulding time is three days or above, a casting can be produced by the Randupson process in less time, and if two or more are required from the same pattern, in very much less time.

In medium castings (*i.e.*, 5 to 15 cwts.) one casting can be delivered in Randupson in about the same time, but, if a number of castings is required from the same pattern, in much less time.

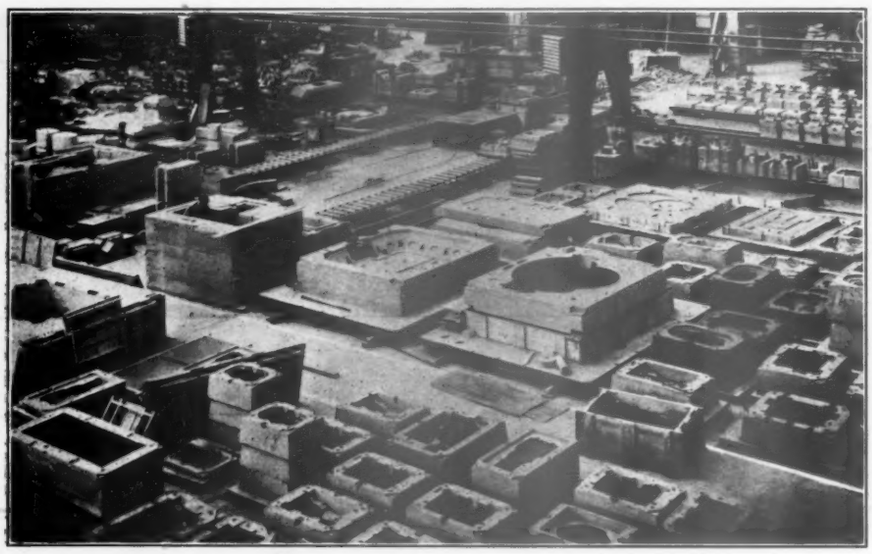


FIG. 18.—VIEW OF FOUNDRY SHOWING LARGER MOULDS FOR CAST IRON.

FIG. 20.—PUTTING TOGETHER PARTIALLY-STRUCK-UP RANDUPSON CASTING.

For small castings normally cast green sand, one casting will take two days longer in Randupson, though a number can be produced in the same time.

Of the second disadvantage, *i.e.*, room required for storage, there is no question but that, taken on the whole, a jobbing foundry requires 10 per cent. more floor space when using the Randupson process. To some extent this extra floor space may be minimised by storing moulds in racks, and foundries producing nothing but heavy castings can produce more castings per square foot of floor area than with ordinary methods. In steel founding or jobbing work where most moulds are dried, little or no extra space is required.

The third disadvantage, that of all sand having to go through the mills, necessitates a modern sand plant to operate the process. It is not uncommon to-day with many foundries to recondition and desilt *all* sand, and any such foundries need only the addition of a crusher to their plant to enable them to work the Randupson process. Provision of a crusher and desilter is essential to work the Randupson process economically.

The fourth disadvantage needs no comment, and is not difficult to cater for.

The fifth disadvantage, *i.e.*, higher cost of sand in iron founding, has to be offset against savings made in other directions.

The sixth disadvantage is catered for in setting out the pattern or moulding methods, and is mentioned to warn foundrymen that universal applicability of ordinary methods is not possible.

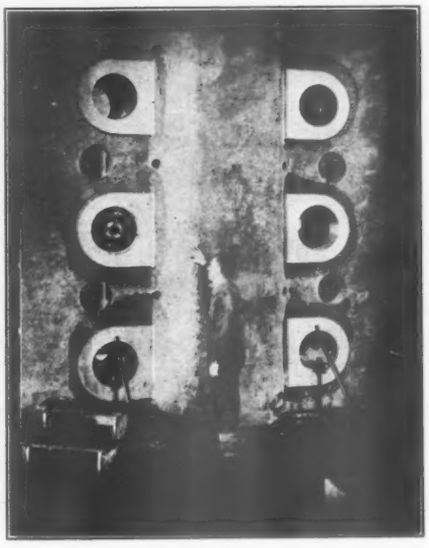


FIG. 19.—MACHINING A 60-TON STEEL CASTING MADE BY RANDUPSON.

Advantages Shown

Having dealt with the various disadvantages of Randupson, the foundryman unacquainted with this unique method of moulding may well ask where the appeal lies against traditional methods.

First of all the author will outline the advantages in ascending order as they appear in practice.

(1) No drying stoves needed and no fuel. No comment is needed on this.

(2) No box parts or no storage space for box parts. Every foundryman can correctly assess the value of this without any further dilation.

FIG. 21.—STRICKLE-MOULDING A WATER-TURBINE CASING.

(3) The castings, either iron, steel or bronze, are *much* truer to pattern—no swells and much less warpage due to greater rigidity and strength of moulds.

(4) No scabbing due to greater strength of moulds.

(5) With suitable sand and working of the process no blowholes due to much higher permeability.

In discussing the advantages, the one which counts the most in practice has been left to the last. That is the speed with which Randupson moulds can be produced in practice. The author gave previously an example which probably sounded incredible to readers, but such is the daily experience of those working this process. Actual moulding times, and by that the author wishes to be very clear that he means moulding times alone—not putting together, coring up, etc., which are the same as in ordinary practice—are reduced from 50 to 300 per cent., and overall labour times from 30 to 75 per cent.; and—also important—much less skill is required—no sprigging, no venting, no careful ramming. In those two facts one has the success of the Randupson process in the field for which it is applicable. The process is in practice quite different from ordinary founding methods and a very great deal of one's preconceived ideas and experience has to be discarded, but in the author's opinion the process is bound to spread rapidly not only on account of the quality of casting produced, but on account of the ease and cost with which such castings—either in iron, steel or non-ferrous alloys—are produced.

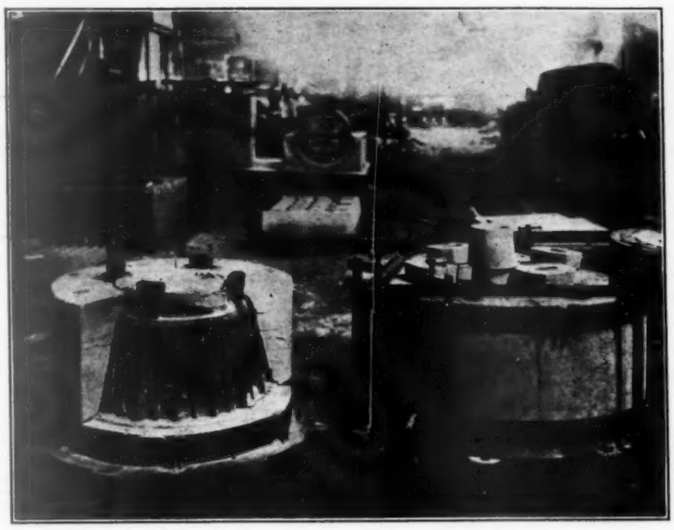


FIG. 22.—MANGANESE-STEEL CRUSHER MOULD READY FOR CASTING AND PARTIALLY STRIPPED.

FIG. 23.—MOULD FOR LARGE STERN TUBE BRACKET IN CAST STEEL.

FIG. 24.—STERN TUBE BRACKET IN CAST STEEL, PARTIALLY STRIPPED.

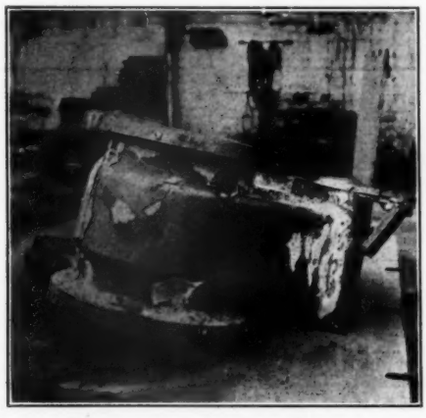


FIG. 25.—35-CWT. VALVE BODY IN CAST STEEL, PARTIALLY STRIPPED.

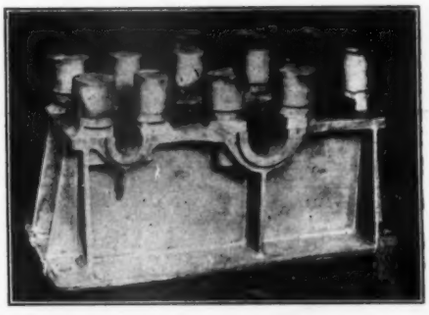


FIG. 27.—CAST-STEEL GEAR CASE IN RANDUPSON.

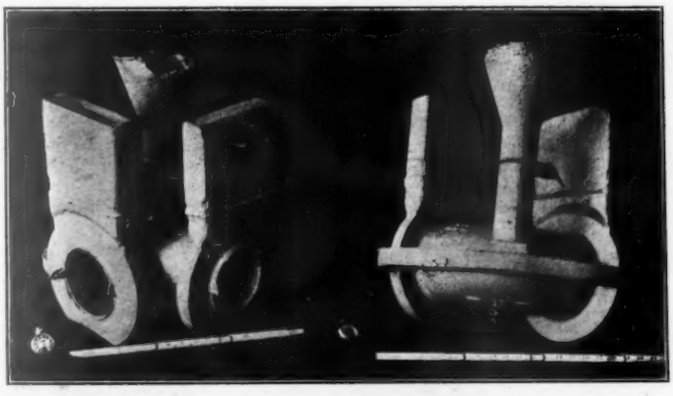


FIG. 26.—CAST-STEEL ELBOWS SHOT-BLASTED ONLY FROM MOULD.

FIG. 28.—MOULD FOR LOCOMOTIVE WHEEL-CENTRE.

In conclusion, the author would like to express his thanks to Mr. David Brown, the managing director of David Brown & Sons (Hudd.), Limited, not only for permission to publish this Paper, but for his continued interest and assist-

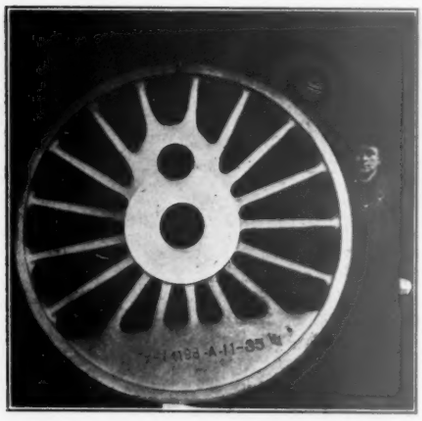


FIG. 29.—LOCOMOTIVE DRIVING-WHEEL CASTING FROM MOULD SHOWN IN FIG. 28.

ance in the development of the Randupson process in the Penistone Works of his company. Thanks also are due to the Société d'Electro Chimie d'Electro-Metallurgie et des Aciéries d'Ugine, for much of the technical information

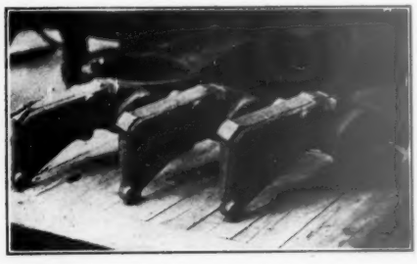


FIG. 30.—SMALL AUTOMOBILE CASTINGS MADE BY THE RANDUPSON PROCESS.

contained in this Paper, and without whose help the successful exploitation of this revolutionary process in the foundries with which the author is connected would not have been possible.

The author acknowledges the help in information and photographs from other licensees of the

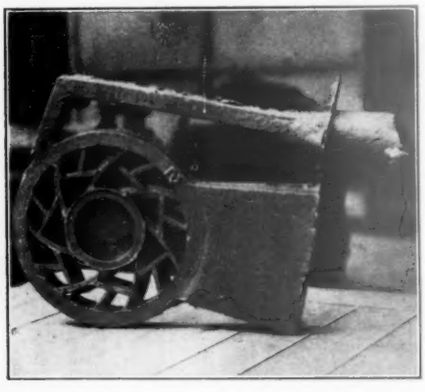


FIG. 31.—SMALL ALLOY STEEL CASTING MADE BY RANDUPSON.

process, including Mr. Marshall Post, Vice-President of the Birdsboro Foundry & Machine Company, Birdsboro, U.S.A., Dr. Guido Vanzetti, Mr. Lewis, of the Manganese Brass & Bronze Company, and the Société des Forges d'Ales of Alais, France.

Dust Collection

FACTORS AFFECTING EFFICIENCY

All too often dust collection systems fall short of the effectiveness expected of them, according to C. A. Snyder, dust control engineer of the American Foundry Equipment Company, because insufficient care has entered into the design and installation of dust hoods and pipings. In some cases, he says, the cub. ft. per min. capacity of the collector is insufficient to handle the volume of dust created. Inefficient operation in many cases is traceable to extreme differences in lengths of branch pipes in a system. This creates an unbalanced condition.

There are twelve important points relative to the design and situation of suction hoods and nozzles which must be taken into consideration in order to permit a dust collection system to work with highest efficiency. They are:—

(1) The use of forces created by the motion of tools on work which produces air currents into hoods.

MR. F. W. ROWE

(Author of the Bradford Conference Paper on the Randupson Process).

(2) Prevention of air currents detrimental to the above action by installation of proper baffles.

(3) Study of existing air currents surrounding the operation that might affect hood efficiency; that is, general building ventilation or adjacent working operations.

(4) Hoods must be as close as is practical to dust creating operation due to the rapid drop in air velocity away from the face of the hood.

(5) Heavy gases or dust are best handled by employing downward currents of air into a hood.

(6) Fumes or light dusts are usually best handled by hoods utilising an upward flow of air.

(7) If either of the above methods intereferes with the process, then cross draft or lateral draft are employed.

(8) Hoods must be designed so that the dust hazard is drawn away from the faces of workers.

(9) Double-walled hoods employing a high-velocity curtain of clean air entirely around the operation are often applied effectively to particularly dirty operations, although this type of hood is patented.

(10) It is generally agreed that an exhaust hood shoud not have more than sixteen times the area of the exhaust pipe connected to it.

(11) Structurally, a hood should be fabricated from materials best suited to the particular application, and should be well reinforced and free from sharp edges. Movable hoods should have simple, positive adjusting devices. Telescoping pipes or knuckle or ball-joints in pipes are necessary with hoods of this type. Flexible metal or rubber hose can also be used with this type of hood. Amply-sized access doors should be provided for adjustment or replacements to equipment being ventilated. It is often desirable to light the interiors of hoods and provide dust-tight windows for observation of the operation. It is often possible for an operation to be entirely enclosed by a hood or room of this type, the operator working through flexible gloves attached to openings in the hood or room wall.

(12) Air velocities across the face of exhaust hoods will vary according to the application and the distance from hood face to operation, air currents in buildings, etc.

I.B.F. Conference

(Concluded from page 508.)

The party left either Bradford or Leeds by motor coach, the first halt being made at Harrogate, where coffee was served in the Valley Gardens. The journey was continued to Ripon, where luncheon was taken at the Spa Hotel, which is beautifully situated in extensive grounds on the outskirts of the city. After luncheon the opportunity was taken to tender the thanks of the members and ladies to the officials of the West Riding of Yorkshire Branch for their hospitality, for the work which they had carried out in connection with the Conference, and to congratulate them upon the success of their efforts.

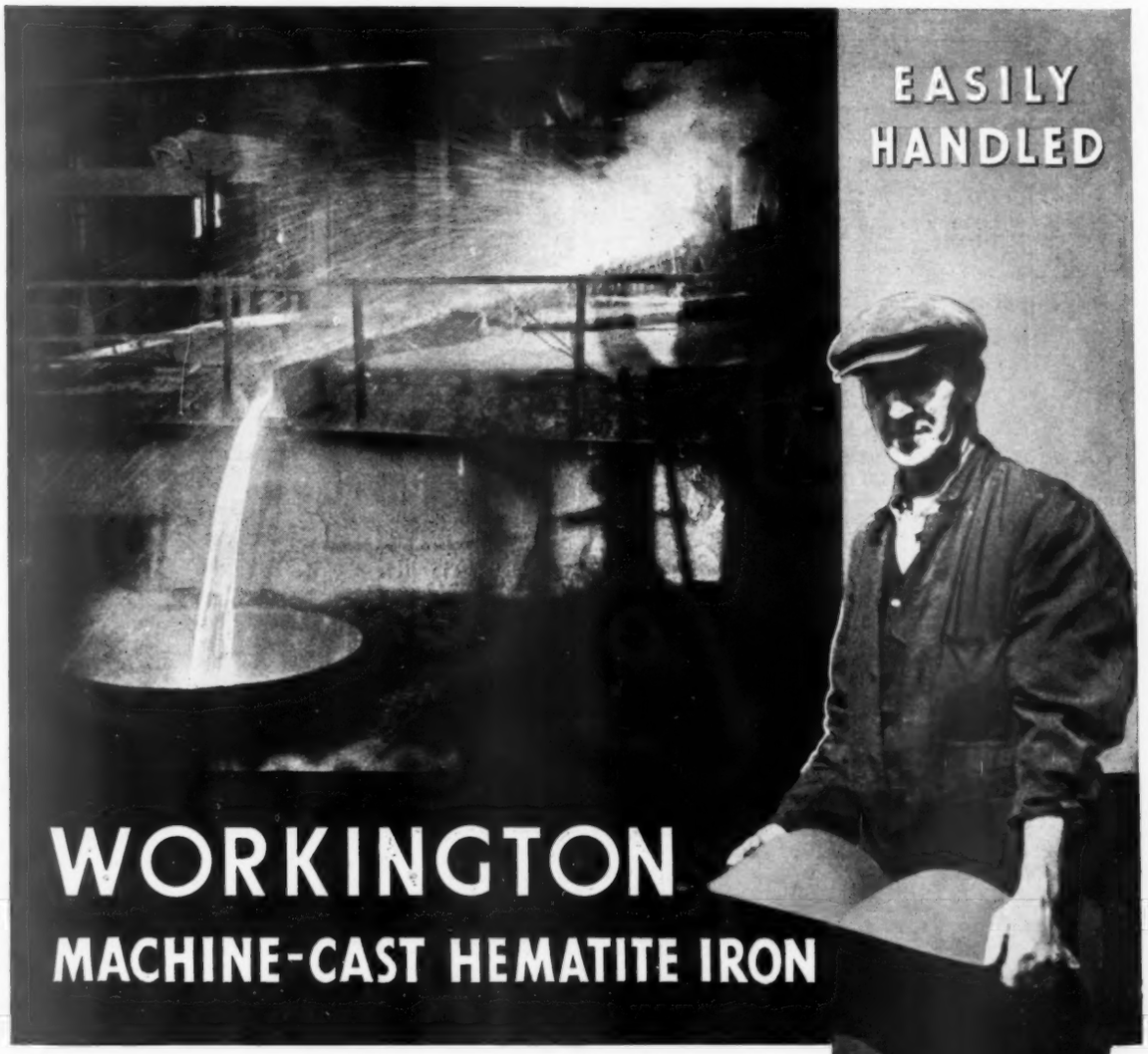
MR. C. W. BIGG (immediate Past-President) voiced the thanks of the Institute, and assured the West Riding of Yorkshire members that all those visiting the Conference had enjoyed it, and appreciated fully all that had been done for them. Mr. Bigg's remarks were supported by MR. H. WINTERTON (Past-President), who stressed particularly the work of Mr. S. W. Wise, the Secretary, and Mr. H. Forrest, the Chairman of the Conference Committee.

MR. S. W. WISE, in replying, said that he was glad that Mr. Forrest had been particularly associated with the remarks, and paid his own personal tribute to the valuable co-operation which he had had from Mr. Forrest. The local Branch felt that their efforts were amply repaid if the members and ladies were satisfied; it was their first Conference, and it had been a great joy to them to entertain the Institute.

The journey was continued during the afternoon by way of Masham and Leyburn and along Wensleydale. A halt was made at Aysgarth, and opportunity was taken to lay in stores of Wensleydale cheese. The party then proceeded along Bishopdale and entered the upper end of Wharfedale, passing through Buckden to Burnsall, where tea was served at the invitation of the President and Mrs. Hepworth.

Mr. and Mrs. Hepworth were thanked for their hospitality, on the motion of MR. V. STOBIE, seconded by MR. D. SHARPE. MR. HEPWORTH replied on behalf of Mrs. Hepworth and himself, and expressed the pleasure which they had had throughout the whole of the Conference, particularly the pleasure which it had given them to entertain the party on that day. He also emphasised the tribute which had been paid to the officials of the West Riding Branch earlier in the day, and added a tribute to Mr. W. G. Thornton, the Conference Treasurer. He also expressed his own personal appreciation to the Lord Mayor and Corporation of Bradford for their hospitality and for the assistance they had rendered in many directions in contributing to the success of the Conference.

The journey continued along Wharfedale, another halt being made at Bolton Abbey, and terminated at Bradford, one coach calling at Leeds *en route*.



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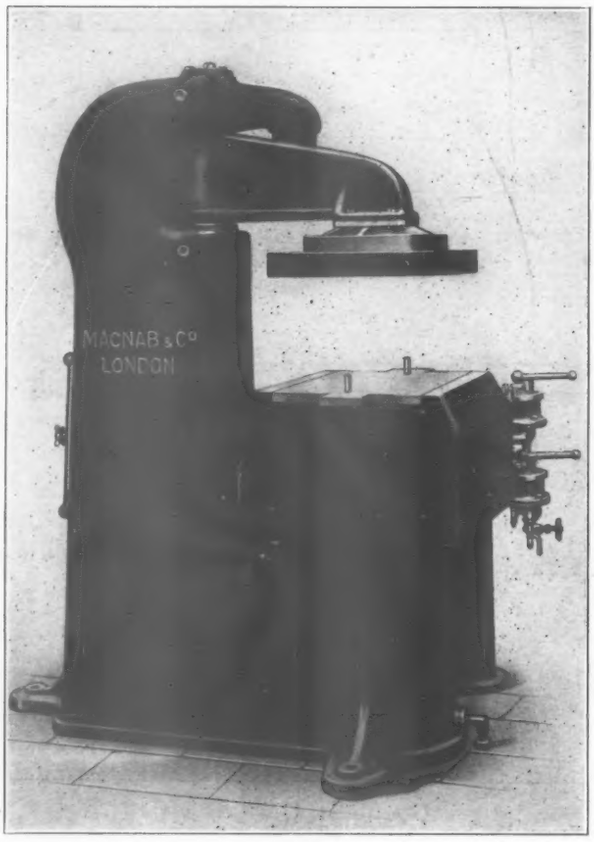

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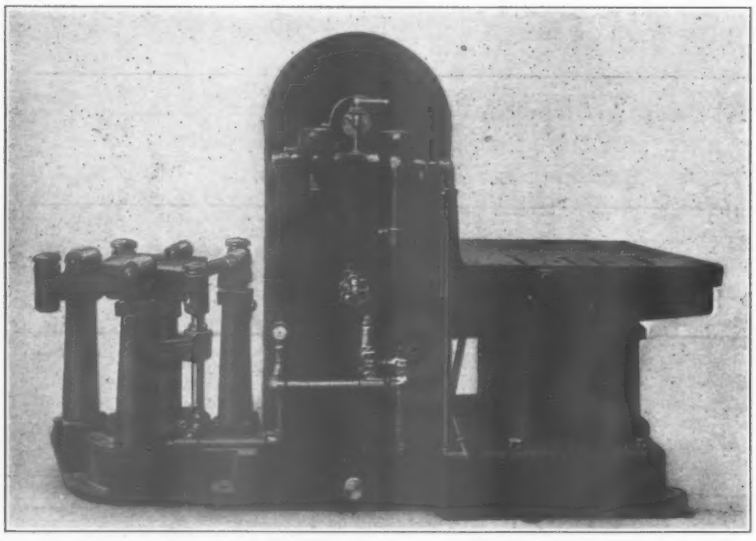

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Relief of Internal Stress in Castings*

By L. E. BENSON, M.Sc.,† and H. ALLISON, B.Sc.(Tech.)†

Whilst some of the harmful results of internal stresses in castings have been known for a long time, little attempt has been made to find out what annealing conditions are necessary for the removal of internal stresses. Internal stresses can result in cracks which may or may not be detected before the castings are finished and go into service. Apart from actual cracking, internal stresses may lead to distortion during machining or in service under easy service conditions.

In the authors' experience distortion of castings and forgings during machining is in the main not due to "machining stresses" (*i.e.*, stresses set up during machining), as frequently stated, but is due to internal stresses initially. These are only revealed when the removal of metal on machining disturbs the balance of the internal stresses, thus allowing distortion to occur until a balance is restored. With proper annealing beforehand, such distortion on machining can be avoided except, perhaps, for special work demanding very close limits.

Another fallacy which it is hoped this Paper will explode is that, in steel castings and forgings, at any rate, objectionable internal stresses revealed by machining are due to casting or forging conditions. The relief of stresses on annealing is essentially a creep phenomenon, but as the bulk of existing data on the creep of steel is concerned with steady loads and temperatures over long periods, the data are not readily applicable to practical annealing conditions where the time is comparatively short and the stress is progressively reduced as annealing proceeds and relief occurs. Furthermore, little creep data exist on materials other than steel.

Procedure

To obtain some information regarding the degree of stress relief to be obtained from different annealing treatments, experiments have been made on cast iron, carbon steel, Admiralty gunmetal and a high-tensile bronze. With each material, test-pieces were carefully machined and ground to size, and pairs of test-pieces were fitted together with a stirrup in the middle, the ends being separated by small distance pieces, as shown in Fig. 1. The size of the stirrup and thickness of distance pieces were chosen to give the required maximum bending stresses at the middle of the span. Each assembly was then annealed in an automatically-controlled furnace, and, after cooling down, the residual stress was calculated from the amount of straightening which occurred when the test-pieces were released from the stirrup.

The maximum fibre stresses in the bars were calculated from the following approximate expression based on the elastic theory.

$$f = \frac{\delta E t}{0.17 l^2}.$$

when f = maximum fibre stress.
δ = deflection of bar measured at mid-length.
l = effective length of bar between supports.
t = thickness of test strip.
E = Young's modulus taken as
13,000 tons per sq. in. for steel;
6,250 tons per sq. in. for cast iron;
7,000 tons per sq. in. for gunmetal and bronze.

It was realised that the method employed is not strictly accurate, and that the stress calculations are based on the assumption that stress distribution in the bars is linear both before and after annealing, which is not necessarily true. The method is sufficiently accurate for practical purposes, however, and, with steel specimens, test results obtained by a less convenient but more direct method have given good agreement with results obtained by the method described here.[1]

CAST IRON

Stress Relief in Annealing

The test-bars were machined from a cast block of grey iron approximately 3 in. square section, so as to represent the conditions existing in a large casting.

An analysis of the material gave the following results:—Gr C, 3.03; C.C, 0.40; Si, 2.02; Mn, 0.38; S, 0.096 and P, 0.64 per cent. The results of the experiments are given in Table I.

MR. L. E. BENSON.

An annealing period of 6 hrs. was chosen first as representing commercial practice with large furnaces, when a fairly lengthy soaking period has to be allowed. Tests A, A_1, B and C (Table I) show the effect of annealing at temperatures varying from 350 to 600 deg. C. with an initial stress of about 5 tons per sq. in., and the results are shown graphically in the left-hand curve in Fig. 2.* This curve shows that the percentage stress relief increased progressively with temperature, the curve falling steeply in the region of 500 deg. C. At 550 deg. C. the curve is flattening out and the initial stress has been relieved by 90 per cent.

TABLE I.—*Stress Relief of Cast Iron on Annealing.*

Specimen.	Treatment.	Thickness. Ins.	Effective length. Ins.	Deflection. Ins.		Stress. Tons per sq. in.		Stress relief. Tons per sq. in.	Stress relief. Per cent.
				Initial.	Final.	Initial.	Residual.		
A	6 hrs. at 350 deg. C.	0.489	11.5	0.039	0.008	5.3	4.21	1.09	20.6
A_1	A re-heated 6 hrs. at 500 deg. C. ..	0.489	11.5	0.031	0.018	4.21	1.69	2.52	60.0
B	6 hrs. at 550 deg. C.	0.511	11.25	0.036	0.032	5.3	0.5	4.8	90.0
C	6 hrs. at 600 deg. C.	0.511	11.5	0.039	0.038	5.54	0.14	5.4	97.5
D	Heated to 500 deg.C.	0.511	11.5	0.039	0.020	5.54	2.7	2.84	51.5
E	Heated to 600 deg.C.	0.511	11.5	0.039	0.031	5.54	1.14	4.4	80.0

The influence of time of soaking for annealing temperatures of 500 and 600 deg. C. is shown by a comparison of tests D and E with tests A_1 and C.

Test.	Annealing treatment.	Stress relief Per cent.
D	Heated to 500 deg. C. No soaking	51.5
A_1	Heated to 500 deg. C. 6 hours' soaking	60.0
E	Heated to 600 deg. C. No soaking	80.0
C	Heated to 600 deg. C. 6 hours' soaking	97.5

It will be noted that a considerable measure of stress relief is obtained merely by heating to the annealing temperature without soaking (the heating time in all cases was about 1 hr.), and with slower rates of heating such as would obtain in ordinary foundry practice the degree of stress relief on merely heating would be greater still.

Growth on Annealing

Whilst it appeared from the above that annealing at temperatures above 550 deg. C. would give substantial freedom from internal stress, it was desirable to know at what temperature growth of iron on annealing would occur. Existing information did not provide the information required, as growth was measured after repeated or lengthy annealing, and the measurements were generally too coarse to be of value after a single treatment. Accordingly tests were made on $1\frac{1}{4}$ in. round sand-cast bars of cylinder iron $13\frac{1}{2}$ in. long.

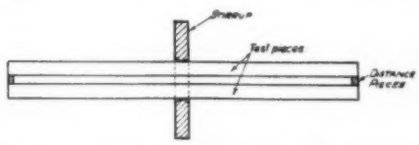

FIG. 1.—ASSEMBLY FOR TESTS TO DETERMINE EFFECT OF ANNEALING PERIOD ON STRESS RELIEF.

The nominal composition of the iron was as follows:—T.C, 3.3; C.C, 0.7; Si, 1.4; Mn, 0.7; S, 0.10, and P, 0.5 per cent.

Tests taken on one bar gave a tensile strength of 13.6 tons per sq. in. and 217 Brinell. Microexamination showed a satisfactory pearlitic type of structure.

Each bar was cut in two and the pieces machined at the ends in line with Fig. 3. The "pips" at the extreme ends were subsequently used for overall length measurements, the shoulders being provided in order that end caps could be shrunk on so as to protect the "pips" from oxidation during annealing. One test-piece from each bar was machined all over the length, reducing the diameter to 1 in., the other test-piece being unmachined except for the ends.

Machined and unmachined bars were annealed at various temperatures in an electric furnace for 6 hrs., overall length measurements being made on each bar before and after annealing.

The measurements made are given in Table II and are shown plotted on the right-hand side of Fig. 2. After annealing at the highest temperature, only the slightest discoloration of the

* Paper read at the Annual Conference of the Institute of British Foundrymen at Bradford.

† Metropolitan-Vickers Electrical Company, Limited.

* Stress-relief temperature curves for cast iron and steel similar to those shown in Fig. 2 were shown in the discussion of a Paper by Machin and Oldham at a meeting of the Lancashire Branch on February 16, 1935. As they were not printed in the report on the discussion, they are included in this Paper.

measuring pips was found, so that no loss of accuracy occurred through oxidation. The measurements were made to an accuracy of 0.00001 in. per in. length of specimen. It will be seen that virtually no growth occurred at 500 deg. C., and at 550 deg. the extension was only 0.0002 in. per in. Above 550 deg. C., however, a very rapid increase in the rate of growth occurs. It is important to note that machined and unmachined specimens behaved similarly.

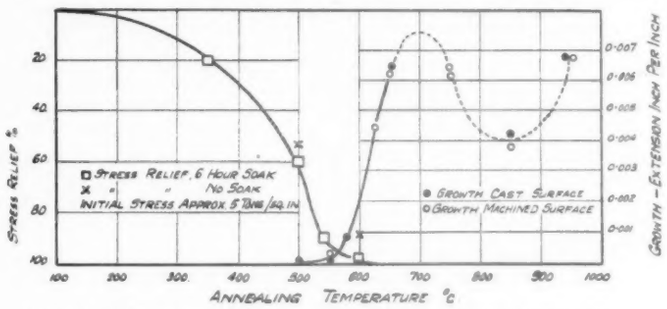
STRESS RELIEF %
GROWTH — EXTENSION INCH PER INCH
ANNEALING TEMPERATURE °C
□ STRESS RELIEF, 6 HOUR SOAK
× " " NO SOAK
INITIAL STRESS APPROX. 5 TONS/SQ. IN.
● GROWTH CAST SURFACE
○ GROWTH MACHINED SURFACE

FIG. 2.—EFFECT OF ANNEALING TEMPERATURE ON THE STRESS RELIEF AND GROWTH OF CAST IRON.

The irregularity in the growth curve in the region of 850 deg. C. was not expected, and has not been investigated further. It may be due to changes associated with the critical range, in which case it would probably be swamped by the growth extension on repeated heating, or on heating for very much longer periods. Considering the stress relief and growth curves together it appears that annealing at a temperature of 550 deg. C. is suitable for cast iron. At lower temperatures substantial stress relief cannot be relied on, and at higher temperatures there is a risk of appreciable growth occurring.

TABLE II.—*Growth of Cast-Iron Bars.*

Annealing temperature. Deg. C.	Cast surface. Total extension. Ins.	Cast surface. Extension. Per in.	Machined surface. Total extension. Ins.	Machined surface. Extension. Per in.
500	0.00005	0.00000	—	—
550	0.00065	0.00013	0.0012	0.0002
575	0.00435	0.0008	—	—
625	0.0222	0.0044	—	—
650	0.03145	0.0063	0.0304	0.0061
750	0.0318	0.0064	0.0307	0.0061
850	0.0208	0.0042	0.0185	0.0037
950	0.034	0.0068	0.03425	0.0068

STEEL

The behaviour of steel has been considered as regards the shape of the stress relief curve with annealing temperature and also as regards the effect of the annealing period. The results are included in detail in Table III. The results obtained on wrought material as well as on cast material are given, but no apology for doing so is made since such good agreement has been found that the results can be considered together as a whole with advantage.

Analyses of the steels are as follow:—

Wrought Steel.—C, 0.13; Si, 0.28; Mn, 0.38; S, 0.036; and P, 0.019 per cent.

Cast Steel.—C, 0.30; Si, 0.24; Mn, 0.71; S, 0.046; and P, 0.034 per cent.

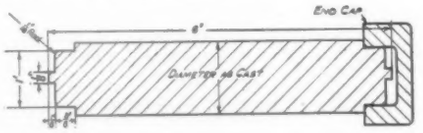

FIG. 3.—SPECIMEN USED TO DETERMINE GROWTH OF CAST IRON ON ANNEALING AT DIFFERENT TEMPERATURES.

The physical properties of the cast steel, which was obtained in the form of a coupon attached directly to a steel cylinder, were as follow:—Ultimate tensile strength, 34 tons per sq. in.; yield point, 16.8 tons per sq. in.; elongation, 28.0 per cent.; reduction of area, 33.6 per cent.; and bend, 127 deg.

The wrought-steel bars were annealed in a laboratory furnace at 880 deg. C. and slow-cooled. The cast material had been annealed for 23 hrs. at 900 deg C. in a large foundry furnace with a load of castings, and after rough machining of the castings it had been further annealed for 4 hrs. at 650 deg. C. and cooled in the closed furnace to 100 deg. C. in 14 hrs.

The stress relief: temperature curve of an annealing period of 6 hrs., which approximates to practical conditions, is shown in Fig. 4. The curve is generally similar to that for cast iron, and falls steeply in the region 500 to 550 deg. C., flattening out to a low residual stress figure at about 600 deg. C. It will be noted that annealing for 6 hrs. at 600 deg. C. has reduced the initial stress in both cast and wrought steel to 5 to 10 per cent.

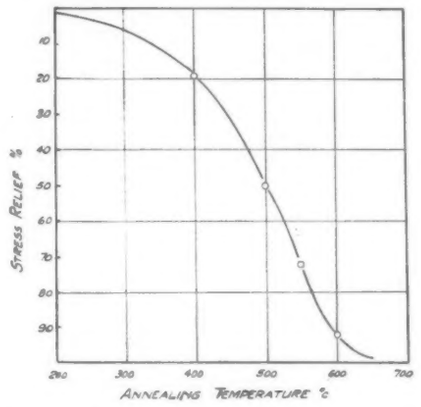

FIG. 4.—EFFECT OF ANNEALING TEMPERATURE ON STRESS RELIEF OF STEEL. (ANNEALING PERIOD 6 HRS. INITIAL STRESS APPROX. 5 TONS PER SQ. IN.)

The effect of the length of the annealing period is illustrated by Fig. 5. Although points are plotted for both wrought and cast material, it is found, allowing for reasonable experimental error, that the points must fall on some such family of curves as is shown. A relatively considerable measure of stress relief has occurred with no soaking period at all, *i.e.*, just heating up to the annealing temperature. In view of this and of the way the curves tend to flatten out, it is clear that within practical limitations the length of the soaking period is of secondary importance to the temperature itself.

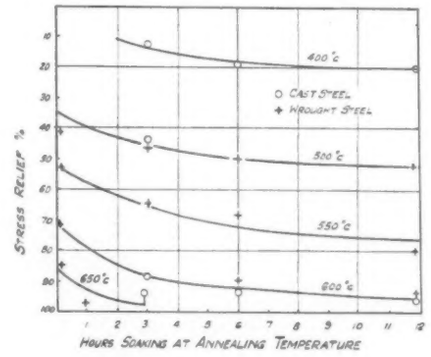

FIG. 5.—EFFECT OF ANNEALING PERIOD ON STRESS RELIEF OF STEEL AT DIFFERENT ANNEALING TEMPERATURES.

(To be concluded.)

TABLE III.—*Stress Relief of Steel on Annealing.*

Specimen.	Annealing treatment.	Effective length. Ins.	Thickness. Ins.	Deflection. Ins. Initial.	Deflection. Ins. Final.	Stress. Tons per sq. in. Initial.	Stress. Tons per sq. in. Final.	Stress relief. Per cent.
Cast steel:								
A	400 deg. C. for 3 hrs.	11.5	0.483	0.020	0.0025	5.6	4.9	12.5
A_1	400 " " 6 "	11.5	0.483	—	0.00375	5.6	4.55	19
A_2	400 " " 12 "	11.5	0.483	—	0.004	5.6	4.5	20
B	500 " " 3 "	11.5	0.500	0.019	0.0085	5.5	3.05	44.5
C	600 " " 3 "	11.5	0.463	0.0175	0.0155	4.7	0.5	88.5
C_1	600 " " 6 "	11.5	0.463	—	0.0165	4.7	0.25	94.5
C_2	600 " " 12 "	11.5	0.463	—	0.017	4.7	0.1	97.5
D	650 " " 3 "	11.5	0.483	0.0215	0.020	6.0	0.4	93
Wrought steel								
3 & 9	500 deg. C. for 0 hrs.	12.0	0.490	0.022	0.009	5.8	3.42	41.0
7 & 8	500 " " 3 "	12.0	0.490	0.022	0.010	5.8	3.16	45.5
1 & 5	500 " " 6 "	12.0	0.490	0.0205	0.0105	5.4	2.7	50.0
11 & 10	500 " " 12 "	12.0	0.490	0.021	0.011	5.55	2.65	52.5
12*a* & 22	550 " " 0 "	12.0	0.486	0.024	0.0125	6.2	2.96	52.5
17 & 20	550 " " 3 "	12.0	0.486	0.0225	0.0145	5.82	2.07	64.5
15 & 16	550 " " 6 "	12.0	0.486	0.022	0.015	5.7	1.82	68.0
14 & 19	550 " " 12 "	12.0	0.486	0.026	0.0205	6.6	1.3	80.5
26 & 27	600 " " 0 "	12.0	0.486	0.025	0.0175	6.45	1.9	70.5
24 & 25	600 " " 3 "	12.0	0.486	0.025	0.0235	6.45	0.37	94.5
30 & 28	600 " " 6 "	12.0	0.486	0.025	0.0225	6.45	0.63	90.0
35 & 36	600 " " 12 "	12.0	0.486	0.025	0.0235	6.45	0.37	94.5
21 & 37	650 " " 0 "	12.0	0.486	0.0195	0.0162	5.0	0.8	85
29 & 32	650 " " 1 hr.	12.0	0.486	0.022	0.0215	5.7	0.15	97.5

REFERENCES.

1 Benson and Allison. "The Low-Temperature Annealing of Welded Mild Steel Structures to Relieve Internal Stresses." Welding Symposium, Iron and Steel Institute, May, 1935.

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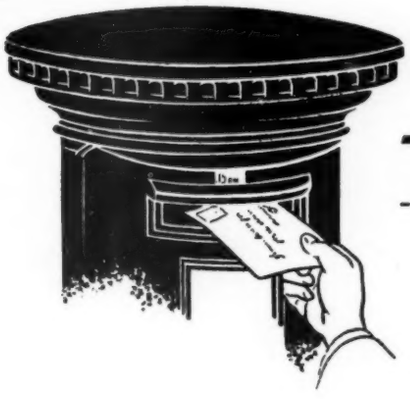

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THE NEW WORKS OF "ABRASIVES," SLOUGH

It is believed that what follows constitutes the first description of the manufacture of chilled iron grit printed in the English language and probably in any other. Up to now, only the general principles have been known, and were summarised by saying that liquid cast iron was poured into water, crushed, sieved and bagged.

GENERAL VIEW OF SIEVING AND BAGGING PLANT.

A visit to the well laid-out works of Messrs. "Abrasives," of the Trading Estate, Slough, Bucks, very clearly indicates that it is a highly technical process, demanding rigid control from start to finish, and to which end a plant, the first and only one of its kind, has been specially designed.

Melting Department

The raw materials are exactly the same as required for grey iron foundry practice, and are brought in trucks to the sidings to a point under the end of the overhead runway. Spanning 150 ft. between the siding and the cupola, the runway serves the purpose of unloading raw material from the trucks into the appropriate storage bins, and again drawing supplies from these bins, and charging them into the cupola.

Beneath this runway, which is supported by a double gantry, is a line of storage bins, those containing scrap metal being nearest to the cupola. As will be seen from the illustration, this makes a very neat lay-out, well worth emulation by certain types of foundries. Metal is brought down in a cupola lined to 36 in., designed by Constructional Engineering Company, Limited. It is blown by a Keith-Blackman fan, and provision has been made in lay-out for an ultimate battery of four furnaces. This will involve no modification in existing lay-out, the plant being so designed that the proposed extensions could be installed without interruption to production.

The furnace is probably blown somewhat harder than for normal foundry practice, and there will be a heavier metallic loss than the normal 6 per cent. The first few hundredweights are pigged to ensure clean metal entering the chilling ponds. There are two ponds about 16 ft. deep, to which water is supplied from a cooling tower 80 ft. high, built over a tank 25 ft. long, 15 ft. wide, and 2 ft. 6 in. deep. This is capable of supplying 32,000 gallons of water per hour.

The water system is operated by a series of pumps from 7 to 45 h.p. These pumps feed, circulate or empty the tanks, and supply water at the required pressure for chilling the metal stream.

The water tower, having as many as 6,500 thin wooden slats in its structure, would in winter hold an accumulation of ice sufficient to constitute a source of danger, so provision has been made for by-passing the hot water direct to the cooling tank instead of over the tower as in summer.

By regulating a valve at a point where the streams of water and liquid metal meet, the operator can produce granulated or round shot, or a mixture of the two at will.

At the bottom of the quenching vats a Redler conveyor, of special design, lifts the metal granules and feeds them into an oil-fired rotary dryer by the Constructional Engineering Company, Limited, the fuel for which is fed from a small supply tank, the level in which is automatically maintained by a self-acting pump which draws from the main supply laid under a specially constructed vault in the main building.

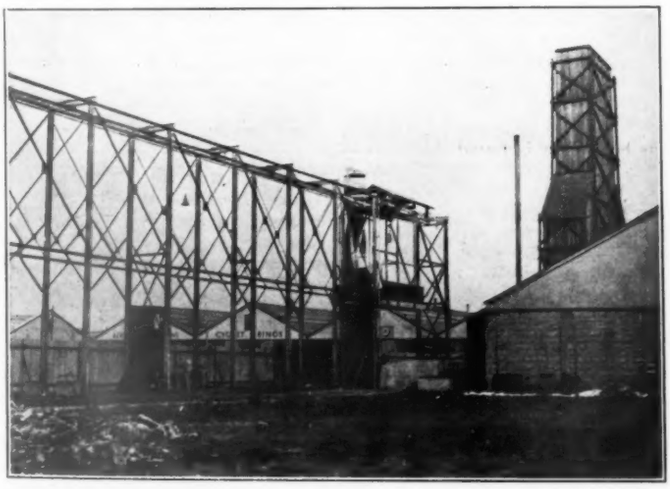
A peculiar and unique feature of this plant is that somewhere at this point provision has been made when both round and angular shot are being blown for the two products to select their appointed circuits through the rest of the plant, so that, entirely unaided by human effort, the round shot separates itself from that intended for crushing, and follows a circuit in which it is classified into shot suitable for grading, and that which must be crushed or remelted, and at this point all scale and particles of rust and dirt which may be present are eliminated and destroyed.

BAGGING OPERATIONS BENEATH SIEVING PLANT.

The selected round shot then passes on its way via the storage bin to the screen, to which it is lifted by bucket elevators. The screen again rejects anything which is unsuitable, such rejections passing into a special bin from which they join the circuit of the material intended for crushing.

The material primarily intended for crushing, having left the round shot at the forementioned point in the circuit, passes, after scale, rust and dirt have been eliminated and destroyed, to a storage bin, from which it is lifted to the crushing mills. It then passes from these mills by

(*Concluded on page* 530.)

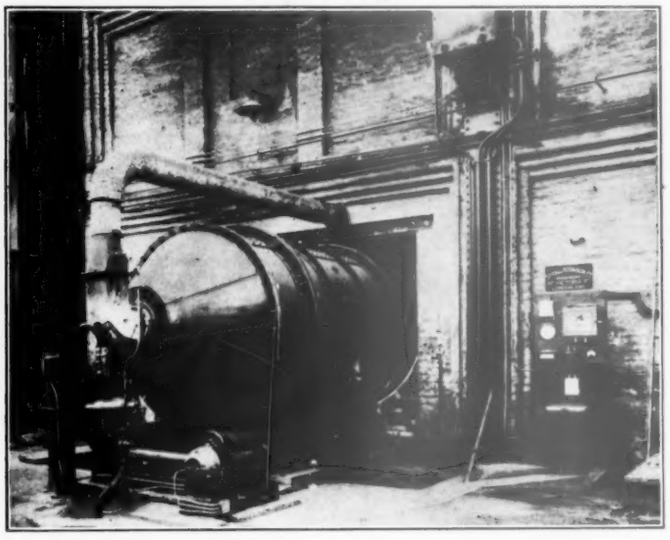


GANTRY SERVING THE CUPOLA PLANT.

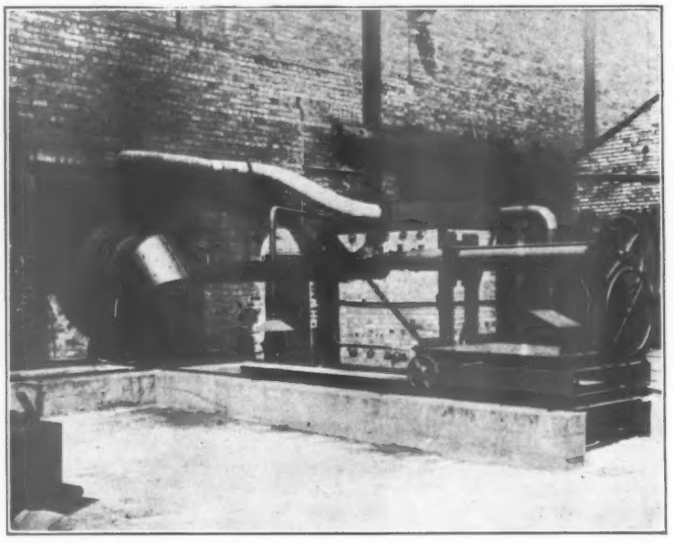
SIEVING PLANT AT "ABRASIVES," SLOUGH.

Britain's Largest Oil-fired Rotary Melting Furnace

During a recent visit to the extensive and well-organised foundries of Glenfield & Kennedy, Limited, of Kilmarnock, advantage was taken of the occasion to procure some details of the construction and operation of what is thought to be the largest oil-fired rotary melting furnace so far installed in Great Britain. The furnace has been designed and supplied by Stein & Atkinson, Limited, of 47, Victoria Street, London, S.W.1. A 2-ton capacity furnace of this type has been in operation in Glenfield & Kennedy's brass foundry for two years. The new furnace has a capacity of 5 tons and is engaged upon the production of high-quality cast iron and using up the firm's output of cast-iron borings. The furnace casing is 14 ft. long by 7 ft. diameter, and is rotated at a speed of 1 r.p.m. by a 5-h.p. motor. It is installed at right angles to the foundry wall with the charging end protruding into the yard. It carries a 15-in. thick lining, the one now in use being rammed from material supplied by the Midland Monolithic Furnace Lining Company, Limited, of Leicester, whilst the spare body is being rammed with material from Pickford, Holland & Company, Limited, of Sheffield. Thus, at a later date, a comparison of life under the conditions existing at Kilmarnock will be available.



FIVE-TON STEIN & ATKINSON OIL-FIRED ROTARY FURNACE AT GLENFIELD & KENNEDY'S WORKS.



EXHAUST ELBOW, CHARGING MACHINE AND RECUPERATOR.

As fuel, Shell-Mex Britoleum is used. It is delivered to a tank in the yard from which it is pumped up to a small service tank situated above the switchboard on the inside of the foundry wall close to the furnace. A float fitted to a contactor switches the pump motor into action when the oil in the service tank reaches a predetermined minimum level. As the oil is liable to be too viscous in cold weather, there are three 1,500-watt heating elements placed in the oil circuit immediately before the burner. Each one is shown to be working by a pilot-light fixed to the switchboard.

The burner is of Stein & Atkinson's own design and utilises preheated air, the temperature of which is pyrometrically recorded. A temperature of 300 deg. C. is attained by the air when the furnace is at tapping temperature. This preheating is effected, after charging is completed, by rolling into position a refractory-lined exhaust elbow which conducts via a downtake and culvert the products of combustion around a series of steel tubes, housed in a recuperator, and thence to a stack situated some little distance away. The air for combustion is driven through the tubes within the recuperator by a fan and is controlled by a butterfly valve at the burner. Provision is made against overheating of the recuperator tubes by the installation of a by-pass damper and also by a cold-air injector, so that the temperature of the tubes is thereby controlled at 850 deg. C.

Operation

The furnace is charged mechanically by a machine designed by Glenfield & Kennedy's engineering department. It is frankly of an experimental character, but is doing good work. The machine is mounted on wheels running on rails, along which it is pushed manually. Semi-cylindrical troughs are provided which are quickly attached or removed from the headstock of the machine. They carry 10 cwts. of metal and are hoisted up to the charging machine by means of a specially provided hydraulic crane. When fixed to the charger the trough is rotatable either clock-wise or counter-wise so that the charges are somewhat spread inside the furnace. Using such light material as borings it is found that the last 10 cwts. of the charge must be charged by hand.

Between the removable exhaust elbow and the furnace proper is a hinged door, which reduces the charging hole to the appropriate dimensions for the exhaust flame. After charging up and closing the door the joint between the door and the shell is made good with refractory to protect the shell from any flame which would leak between the faces.

The furnace was started up in April, and at the time of the visit about 35 heats had been made and the reduction in the thickness of the lining was of the order of 2 in. It was pleasing to note that the casing was in perfectly good condition and in no way warped. A warped condition has been observed in some of the earliest attempts at making rotary furnaces. The tap hole and slag notches are closed with loam backed by floor sand. Some installations, by the way, use oil-sand cores for this purpose. When working from cold, the melting cycle is of the order of 3½ hrs. but with the second charge this is reduced to 2 hrs. The oil consumption works out about 45 galls. per hr., and in this case is measured by a Glenfield & Kennedy rotary meter situated just beneath the burner. The electricity consumption is so low that no special metering has been thought necessary. The change in composition during melting varies according to the nature of the material charged. When working with lump scrap and pig only, the silicon and carbon losses are very low, but when dealing with borings the silicon, carbon and manganese need careful correction. With a heat of borings alone containing 1.8 per cent. silicon the resulting metal contains 0.8 per cent. silicon. The carbon is kept at 3 per cent. by charging 1 cwt. of coke breeze for each 10 cwts. of borings. The manganese content is adjusted by ferro-manganese just before tapping. For castings, the metal is checked before opening the tap hole, by means of a wedge test. The metal is then used in exactly the same manner as cupola iron and inoculated in the usual way for the production of Meehanite. The melting costs are somewhat in excess of cupola melting, whilst the ability to use up cast-iron borings makes it an attractive melting unit, because of the cheapness of the charge.

Grateful acknowledgment is made to the facilities kindly accorded by Mr. H. Gardner, the works manager, and to the help given by Mr. J. E. O. Little, the works metallurgist at Glenfield & Kennedy, Limited.

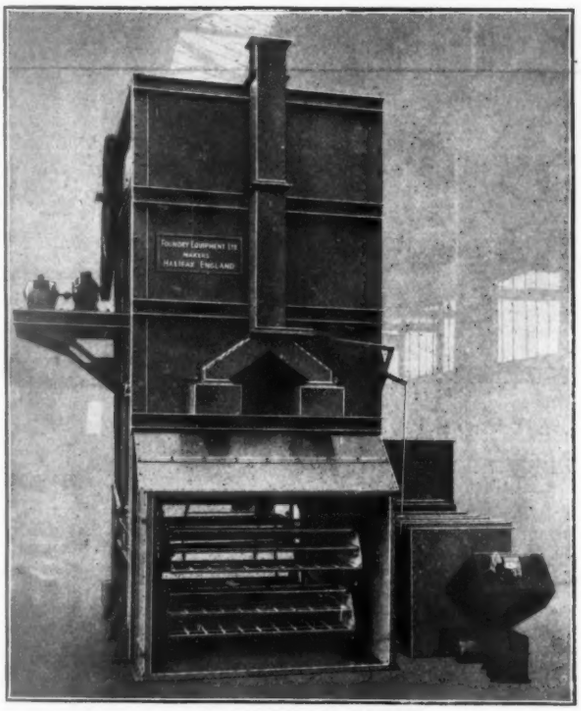
A Modern Chilled-Shot Factory

(*Concluded from page* 529.)

means of elevators to a storage bin *en route* for grading. In this circuit the crushed material is dealt with in a way to send back for re-crushing anything which is unsuitable for screening.

Having reached the storage bin, this crushed material is taken by elevators to the screen, where it is correctly graded, deposited into the appropriate hopper, from which it feeds through the appropriate spout into the numbered bags waiting to receive it. A further unique feature of the screening of this material is that the screen grades round shot and angular grit at the same time.

It is remarkable to note that the time taken by the whole process is approximately thirty minutes, that is, from the moment of lifting the scrap into the electric hoist to the moment it is fed, graded into bags for despatch. The process produces no fewer than twenty-five accurate grades; this has never previously been attempted, and closer grading than this can be regarded as a technical impossibility.



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Storage Hoppers and Chutes fitted with hand or mechanically operated discharge.

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  (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

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● ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

● **Typical Cylinder Pig Iron Specification**

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

● **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

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British Non-Ferrous Metals Research Association

The Eighteenth Annual Report of the British Non-Ferrous Metals Research Association was presented to a general meeting of the members at the Savoy Hotel, London, last Monday. From the extracts given below it will be seen that the Association is now paying much more attention to the requirements of the foundry industry than has been the case previously.

Extension of Laboratories

The Euston Street scheme for extension, adopted by the Council at the end of 1936, was outlined in the last Annual Report. Its execution has been facilitated by the purchase, in September, 1937, of the freehold of the building (Nos. 1 to 6, Regnart Buildings) held on lease and occupied by the Association since 1930. The total freehold property now owned by the Association is about 13,000 sq. ft. in ground area, of which roughly one-third is occupied by the old building and one-third by the building now being erected, while the remainder is reserved for future extension.

The new building, of steel frame with brick walls and fire-resisting hollow tile floors, has a Euston Street frontage of 90 ft., width of 32 ft. externally, and over-all height from basement floor to flat roof of 47 ft., divided into four floors. A space 20 ft. wide between the new block and the north wall of the old block will accommodate, at street level, the loading dock required by the London County Council and a single storey melting-shop at semi-basement level. The main entrance and staircase and the intercommunicating staircase between the new and old blocks are situated at the western end of the new block, leaving on each floor an internal floor area of about 2,000 sq. ft. for laboratories, etc.

The Financial Position

Income in 1937 was considerably in excess of ordinary expenditure. During the year, however, more than £20,000 was spent in the purchase of property, consuming all the year's savings and more than half of the accumulated reserve. Not less than a further amount of £25,000 is likely to be required, nearly all before the end of 1938, to complete the new building, and to provide for necessary alterations to the old building and for new equipment. Research activity will increase when the extensions are taken into use and ordinary expenditure is likely to overtake very soon the present rate of income of about £30,000 per annum from all sources. Further growth of membership support is the only possible basis for a steady advance in the activity and usefulness of the Association.

Research Programme

Considerable demands on the time of senior staffs have been made by the new building, and, for this reason, progress in a few researches has been less rapid than would otherwise have been the case. On the whole, however, the wide research programme now in hand has been steadily advanced. For instance, the various researches concerned with melting and casting problems in aluminium alloys, tin bronze and nickel silver have definitely extended existing knowledge of the factors which control the soundness and uniformity of ingots and castings. Important progress has been made in work on mechanical properties (especially creep under prolonged stress), corrosion and protection, electrodeposition and other investigations in the miscellaneous group.

A feature of recent developments has been the extension of co-operation with other organisations interested in metallurgical research. The British Cast Iron Research Association is providing materials for testing for suitability as melting pots for aluminium, while joint researches with the Institution of Civil Engineers on Soil Corrosion of Metals, the Institute of Welding on the Weldability of Non-Ferrous Metals, and the Institution of Automobile Engineers on Deep Drawing are in progress or planned. The Association is co-operating with the technical organisations of the steel industry in an inquiry into the possibilities of research on rolling and rolling mills, and with the Electrodepositors' Technical Society in drafting technical clauses for specifications for electrodeposited coatings.

Council

Since the last Annual Report the following have been co-opted as members of the Council:—

Mr. Edward J. Bolton (Thomas Bolton & Sons, Limited).

Mr. W. F. Brazener (representing Cold Rolled Brass & Copper Association).

Mr. P. V. Hunter (Callender's Cable & Construction Company, Limited).

Mr. Harold W. Williams (representing Brass Wire Association).

Staff

The number of staff has increased in recent years in much greater ratio than expenditure, although this is mainly on staff salaries. The chief reason for this apparent discrepancy is the employment of a higher proportion of junior staff, especially laboratory assistants. A scheme providing for the systematic training of this useful class, and for more definite prospects for it, has recently been devised and is expected to have a good effect by encouraging meritorious work.

The Association's laboratories are rightly looked upon by members as a training ground for research workers for the industry, and in general this attitude is to be encouraged. The loss within a few months of four members of the qualified research staff, who left for other posts, has, however, had a temporarily crippling effect on the researches on which they were engaged.

A contributory staff superannuation scheme has been prepared after very thorough consideration by the Finance Committee, has been approved by the Council and is to take effect at an early date.

Progress of Researches

Since the period covered by the previous report, experimental work has been carried out on sixteen major researches, fourteen in the Association's Laboratories and two extra-murally. Amongst these are:—

Aluminium Castings.—In the study of shrinkage in ingots and castings of aluminium alloys, the experimental work of which is linked up with the research on Segregation in Ingots and Castings, temperature gradients are being determined in ingots of different dimensions under controlled conditions of solidification, using a 7 per cent. copper-aluminium alloy with different gas contents. Variations in porosity and composition throughout the ingots are being determined and correlated with temperature gradients. The results so far obtained are of considerable interest and it is hoped that this work will prove a fruitful line of investigation.

On the subject of material for iron pots for melting aluminium and its alloys, experiments are being made to determine the resistance of a wide range of cast irons and alloy cast irons to attack by molten aluminium at different temperatures. These experiments, which have included tests of protective coatings, are now nearing completion.

Further work on the effect of grain refinement on the tensile properties of cast aluminium alloys has been carried out and tests on the corrosion resistance of grain-refined alloys are in progress. Included in the present programme of this research is the further investigation of the reaction between molten aluminium and water vapour and the effect of gases other than hydrogen on the soundness of aluminium alloys.

Melting and Casting of Bronzes.—Experimental work has been mainly concerned with the determination, under carefully controlled laboratory conditions, of the effect of casting temperature and different gas atmospheres on the soundness and tensile properties of 90/10 tin bronze cast in chill or sand moulds. The different atmospheres have included hydrogen, nitrogen, nitrogen with varying percentages of water vapour, nitrogen with sulphur dioxide and carbon monoxide. Three reports have been issued dealing with the earlier stages of the work, which has since been extended to cover the influence of time of treatment in atmospheres containing water vapour. Further work has been done on the influence of sulphur dioxide and carbon monoxide, and the effect of deoxidation and oxidation prior to pouring has also been studied. The results of this laboratory study indicated definite lines for more practical trials, and experiments on a larger scale, using more usual melting and casting methods, are in progress.

Casting of Nickel Silver.—The apparatus and methods used for small-scale laboratory experiments in the work on melting and casting of bronzes have also been used for the preparation of small chill-cast ingots of nickel silvers made under specially controlled conditions. Besides the effect of different gas atmospheres, the influence of small amounts of minor constituents such as sulphur, carbon and oxygen have been studied, and results have thrown a good deal of light on the causes of unsoundness in these alloys. The experimental work is now being directed towards the casting of ingots on a larger scale and a study of the various factors affecting soundness under manufacturing melting and casting conditions.

Members of the Sub-Committee have kindly provided opportunities for the investigators to visit their works and study current methods of production of ingots and sand castings, and also to examine samples showing defects. The review of published information, undertaken as a preliminary to the experimental work, has been considerably amplified to include worked alloys and has now been published by the Association.

Segregation in Ingots and Castings.—The review of the subject of inverse segregation and its literature, prepared by Mr. Vaughan, has been published by the Institute of Metals, and has formed the basis of discussions of the subject in Sheffield, Manchester and London. The experimental work has been mainly concerned with the 7 per cent. copper-aluminium alloy in conjunction with the investigation of shrinkage in aluminium ingots. This work is providing quantitative information on the effect of factors such as temperature gradients, porosity and shrinkage on the extent and character of the segregation in these alloys.

Other subjects being studied are:—The properties of lead; copper alloys for high-temperature service; properties of soft solders; creep of non-ferrous metals and alloys; elastic properties of non-ferrous metals and alloys; deep-drawing properties; galvanising and zinc coatings; condenser-tube corrosion; corrosion of copper (water service pipes, etc.); corrosion of lead; influence of aluminium on the corrosion, oxidation and scaling of brasses; soil corrosion of metals; metallurgical applications of the spectrograph; removal of bismuth from copper, and the electrodeposition of metals.

THE DIRECTORS of Stewarts and Lloyds, Limited, have called meetings for July 5 in Glasgow to consider resolutions providing for an increase in the capital.

The Week's News in Brief

Trade Talk

MUREX WELDING PROCESSES, LIMITED, have moved to new offices and works at Hertford Road, Waltham Cross, Herts.

THE U.S.S.R. IMPORTED foundry and moulding equipment to the value of about £30,000 from the U.S.A. during 1937.

THE BLYTH DRY DOCKS & SHIPBUILDING COMPANY, LIMITED, have received orders from the Admiralty for three more boom defence vessels.

NEARLY 300 EMPLOYEES of John Lang & Sons, Limited, lathe manufacturers, of Johnstone, will participate in a trip to Morecambe on Saturday.

THE VULCAN FOUNDRY, LIMITED, Newton-le-Willows, has obtained a contract for the supply of ten Diesel-engined rail cars for the New Zealand Government.

THE NEW SPORTS PAVILION of Rolls-Royce, Limited, Derby, will be opened on June 29. It is hoped that Lord Herbert Scott, the chairman, will perform the ceremony.

THE DISPUTE at the works of W. & J. Lawley, Limited, Britannia Foundry, West Bromwich, where 85 moulders ceased work nearly three weeks ago, an action which resulted in over 100 other employees being thrown idle, has not yet been settled.

MR. JOS. WEIL, 39-40, Mitre Street, London, E.C.3, has been appointed representative in the United Kingdom for the sale of Buckeye silica firestone and kindred products, manufactured by the Cleveland Quarries Company, Cleveland, Ohio.

THE DOVER ENGINEERING WORKS, LIMITED, of Dour Iron Foundry, Dover, have designed and placed on the market a cover for air-raid shelters of novel construction. It is being exhibited at the Building Centre, 158, New Bond Street, London, W.1.

NO CHANGE is to be made for the present in the rate of wages for men whose conditions are governed by the Welsh Engineers' and Founders' Conciliation Board. This decision was reached at a meeting of the Board at Swansea on June 16, when they discussed the proposal for a reduction of 5 per cent. in wages. No agreement was reached by the members.

NINE ACRES OF GROUND adjoining the Fullwood Works, Mossend, of the Fullwood Foundry Company, Limited, have been acquired for extension purposes. The main shop will be extended by 150 ft. The works at present produce castings up to 50 tons, but castings up to 80 tons will be made later. A large extension is also to be made to the Hamilton Foundry, consisting of a new dressing shop for general castings of all descriptions and manufactures for steelworks, shipyards, etc.

Contracts Open

Bedlington, June 27.—Cast-iron water mains, for the Urban District Council. Mr. W. Hall, surveyor, Council Offices, Bedlington.

Derwent, June 30.—Supply and erection of two electrically-driven centrifugal pumps, for the Rural District Council. Mr. H. Bell, Barlby, Selby.

Thornhill, June 25.—Supply and laying of 600 yds. of 3 in. dia. iron pipes, for the Chapel-en-le-Frith Rural District Council. Brady & Partington, engineers, Market Street, Chapel-en-le-Frith. (Fee £1, returnable.)

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Foundries Engineering Company (Manchester), Limited.—Capital £500. Directors: H. Doughty, 48, Preston New Road, Southport; S. G. Harrison and E. Jackson.

Hugh Campbell (London), Limited, Kent House Lane, Beckenham, Kent.—Capital £1,000. Manufacturers of elevators, hoists, cranes, etc. Directors: H. Campbell, E. Campbell and H. J. Johnson.

Personal

COMMANDER SIR CHARLES CRAVEN has been re-elected President of the Tyneside Industrial Development Board.

SIR CHARLES H. BRESSEY has accepted the invitation of the council to become president of the Junior Institution of Engineers for next session, 1938-39.

MR. F. AUBREY RUSH, of the "Manchester Guardian" editorial staff, has been appointed to the publicity department of the Coal Utilisation Council.

MAJOR RICHARD MILES, whose election as Junior Vice-President of the Institute of British Foundrymen was reported in the JOURNAL last week, comes of a family who have been directly engaged in the ironfounding business for many generations. He graduated in Mechanical Engineering from Sheffield University, and after completing his works apprenticeship, spent six months in a German works in Duisburg. On the outbreak of the war he was transferred to the 3rd Battalion of the Yorkshire Light Infantry and Machine Gun Corps in France and Palestine, being demobilised in March, 1919, with the substantive rank of Major. Immediately after the war he was appointed assistant to the general manager of Newton, Chambers & Company, Limited, holding the appointment for eight years until he succeeded as general manager, later becoming a local director. In 1932, he was appointed to succeed Mr. Malcolm Blair as general manager and director of Head, Wrightson & Company, Limited, and a year later was made managing director. Major Miles has always been keenly interested in the development not only of foundry technique but of markets. As an example, during the housing shortage of 1926, Newton Chambers made hundreds of complete dwelling houses of cast iron. As managing director of Head, Wrightson he has the responsibility of probably the largest output of general iron castings in the country, and one of the largest outputs of steel and alloy castings.

Obituary

MR. GEORGE HENRY TIMMINS, who retired from business as a brassfounder about ten years ago, died on June 13. Mr. Timmins was 82 years of age and had been associated with a Birmingham business established by his father in 1830.

MR. WILLIAM CROSBY, who was a managing director and deputy chairman of Edgar Allen & Company, Limited, retiring in June, 1930, has died at the age of 74. He established the firm's South African business in 1894, and was made a director of the company in 1900.

Company Reports

International Combustion, Limited.—Interim dividend of 7½ per cent.

Hammond Lane Foundry Company, Limited.—Interim dividend of 5 per cent.

General Electric Company, Limited.—Dividend of 10 per cent., plus a cash bonus of 10 per cent., on the ordinary stock.

Electric Furnace Company, Limited.—Net profit for the year ended March 31, £27,579; brought in, £6,513; taxation reserve brought back, £1,000; final dividend of 4½ per cent. on the cumulative preferred ordinary shares, making 8 per cent.; final dividend of 5½ per cent. on the ordinary shares, making 8 per cent.; general reserve, £10,000; carried forward, £8,972.

Wheesoe Foundry & Engineering Company, Limited.—Profit for the year to March 31, including interest and profit on investments realised, £138,198; depreciation, £5,829; welfare schemes and provident funds, fees, etc., £3,580; bonus to staff and workmen, £5,000; taxation, £39,925; brought in, £9,889; to general reserve, £25,000; dividend of 30 per cent., £43,500; carried forward, £25,253. Meeting, June 24.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

484,726. PYRENE COMPANY, LIMITED (Parker Rust Proof Company). Coating of ferrous articles.

484,757. METALLGES. AKT.-GES. Concentrating low-grade iron ores.

484,835. HATFIELD, W. H., and BRIDGE, J. F. High-tensile alloy steel.

484,864. SCHOEMANN AKT.-GES. Shears for cutting rolled metal in movement.

484,904. METAMINE GES. Prevention of interalloying in multiple-layer galvanising baths.

484,908. DEUTSCHE EDELSTAHLWERKE AKT.-GES. Permanent magnets prepared by compressing finely divided magnetic material.

484,909. STEVENS, A. H. (Strip Tinplate Company). Method of coating metal bodies.

484,930. OUBRIDGE, W. A. Casting of piston and like metal packing-rings.

484,935. KOHLER, W. C., and MAUTERER, A. Sheet-piling.

484,943. TRIGGS, W. W. (American Rolling Mill Company). Rolling metal.

484,958. NESFIELD, A. C. Refining of pig-iron and the production of steel or alloy steels.

484,983. SCHREIBER, F., and METAMINE GES. Method of and apparatus for zincifying iron articles.

485,024. MORRIS & SON (BIRMINGHAM), LIMITED, W., and HUNN, F. R. Means for cleaning the rolls of rolling-mills.

485,042. AKT.-GES. OEDERLIN & CIE. Further treatment of cast annular metal articles.

485,047. HERBERT, LIMITED, A., LLOYD., A. H., and BEENY, H. H. Surface-hardening of V-shaped rails for supporting machine-tool or other slides.

485,049. NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPENFABRIE-KEN. Production of magnetic material and of magnetic cores made therefrom.

485,074. BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Manufacture of alloys for permanent magnets.

485,083. NATIONAL COKE & OIL COMPANY, LIMITED, and STREVENS, J. L. Manufacture of solid fuel.

485,130. EVANS, W. E. (Demag Akt.-Ges.). Rolling-mills.

485,231. GROVES, W. W. (Sykes, W. E.). Surface-hardening of metal articles.

485,310. RHODES, C. J. Presses for cutting and/or drawing sheet metal.

485,348. STASSINET, T. Continuous heating furnaces.

485,432. SCHWIETZKE, G. Metal moulds for centrifugal casting of metals.

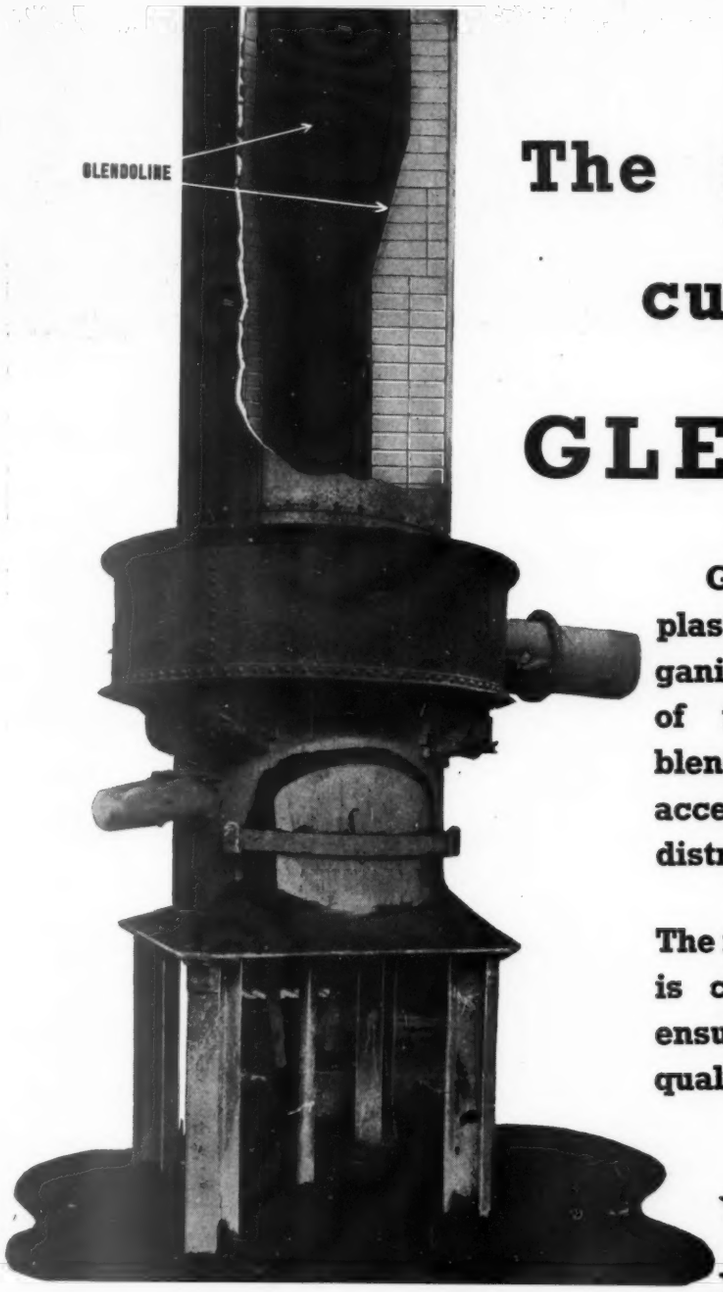
485,443. WILLIAMS, W. P. (American Rolling Mill Company). Mechanism for rolling endless lengths of metal in reversible mills.

485,474. EISENWERK - GES. MAXIMILIANSHUTTE. Manufacture of hardened rails.

485,651. DENNEEN, F. S., DUNN, W. C., and MITCHELL, C. N. Surface-hardening of metal articles.

Company Meeting

MR. JAMES A. MORRIS, Ayr, presided at the annual meeting of Glenfield & Kennedy, Limited, in Kilmarnock, recently. Referring to the company's activities and prospects, he said that production of standard waterworks equipment had again occupied the works to their full economic capacity, and the orders in hand and in prospect indicated that that condition would continue during the current year. Further important orders for hydro-electric schemes had been secured, some of these of a new and special type and others repeat orders. Export trade continued on a satisfactory basis, and new connections had been directly established with the Turkish Government, particularly in regard to irrigation work. The contract for 50 sets of independently operated sluice gates, which were supplied for the Gebel Aulia dam on the White Nile, had now successfully passed the guarantee period, and that equipment had been officially taken over by the Egyptian Government.



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Raw Material Markets

Orders on the books of iron and steel consumers are still rather smaller than is usual at this time of the year and no early expansion seems to be likely to materialise. Heavy stocks of both iron and steel are on hand and, as consumption is below normal, it will be a long time before the supplies at the consuming plants are absorbed.

Pig-Iron

MIDDLESBROUGH.—It would appear likely that a further reduction of pig-iron production will shortly take place, as much of the current output is being put into stock and consumers' requirements are easily met. A few small tonnages are changing hands, but forward contracts are not now being entered into. Many iron users have still quite substantial tonnages of foreign iron on hand, but imports have ceased. No. 3 Cleveland G.M.B. foundry iron is quoted at 109s., No. 1 foundry at 111s. 6d., and No. 4 foundry and No. 4 forge at 108s. per ton, delivered in Middlesbrough and Falkirk. The hematite market remains very poorly supported. Consumers appear to have bought as far ahead as they desire and current transactions involve only small tonnages. For delivery on the North-East Coast, hematite mixed numbers are quoted at 132s. 6d., 138s. in Sheffield, 140s. 6d. in Manchester, and 143s. 6d. in Birmingham.

LANCASHIRE.—A welcome feature in this area is the improved conditions among the light-castings founders, but there is still much leeway to make up before normal activity is attained. Apart from a few third-quarter commitments, little forward buying is being done. Heavy electrical engineers and machine-tool makers are well employed, but jobbing foundries are unsatisfactorily engaged. The demand for hematite remains quiet. For delivery to Manchester and district, Staffordshire and Derbyshire brands of No. 3 foundry iron are quoted on the basis of 114s. per ton, with Northamptonshire at 112s. 6d. West Coast hematite is quoted at 141s., with East Coast material at 140s. 6d. per ton.

MIDLANDS.—There is little change to report in the condition of the pig-iron market in this area; while a few consumers have booked tonnages for third-quarter delivery, the majority are well stocked and, no advantage being offered financially, prefer not to add to their supplies on hand. Most of the light-castings foundries are still working short time, but some improvement in the building trade being recorded, a few have slightly better order-books. The call for low-phosphorus iron is satisfactory and there is quite a good turnover in this grade. A large proportion is passing to firms engaged on rearmament, but there is a fair demand from other consumers, also. Some users of hematite have contracted for their requirements up to the end of the year, but long-term business is still not generally favoured, owing to the comparatively high prices now ruling.

SCOTLAND.—The absence of new business continues to be very pronounced. Consumers, being well stocked, have no need to make new contracts. No. 3 foundry iron is at 118s. and No. 1 at 120s. 6d., f.o.t. furnaces. It is likely to be several months before consumers return to the market for parcels of any size. Hematite mixed numbers are quoted at 133s., Scottish basic at 107s. 6d., and English and Indian basic at 100s., all less 5s. per ton rebate and delivered local steelworks. Consumption of iron at the steelworks is heavy, but they are well covered ahead.

Coke

There has been a slight improvement in the demand for foundry coke recently, but consumers are still refraining from booking forward in most cases. Prices will remain at present levels up to the end of the year. Best Durham foundry coke is quoted at 50s. 6d., with Welsh coke at from 50s. 6d. upwards, both delivered Birmingham and Black Country stations.

Steel

The opening of the holiday season is exercising an influence upon the steel market and the prevailing quiet conditions have become rather more pronounced. On the whole, however, industrial activity is maintained at a fair rate, although it is considerably below the level ruling during the boom conditions of a year ago. The semi-finished steel section of the market is congested with larger quantities of steel than can be conveniently handled, and the volume of new business has sharply declined since the beginning of the year. The situation at the heavy-steel works is more satisfactory, and although outputs have had to be reduced lately to bring them into closer relation with the demand, operations are maintained at a comparatively high level. The lighter branches of the industry, however, are not well supplied with orders and will have to await a reduction in the stocks which have accumulated at users' works before any marked improvement can take place.

Scrap

No expansion in the demand for iron and steel scrap is visible and the immediate future offers no better prospects. Merchants have heavy stocks for disposal, but consumers are already in possession of too much material to meet their current requirements and deliveries under existing contracts are having to be stacked in their yards.

Metals

There has been a better tone in the metal markets this week and prices have moved up, although there has been no particular buying movement.

Copper.—The copper statistics for the month of May were rather disappointing. The American Copper Institute reports that world refined stocks showed an increase of 12,770 short tons over April and of 263,000 tons over May, 1937, at 554,350 tons. The increase was entirely in the United States. The world output of refined metal in May was 149,340 tons, against 162,588 tons in April and 204,140 tons in May of last year. The production of blister copper totalled 156,210 tons, against 155,007 tons last month and 209,100 tons in May, 1937. The world apparent consumption amounted to 136,650 tons in May, as compared with 161,261 tons in April and 196,060 tons a year ago.

Copper producers subscribing to the restriction scheme (Rhodesia, Chile and the Belgian Congo) have decided that the output quota shall be cut by 105 per cent to 95 per cent. of agreed tonnages as from July 1. Production of copper in the chief countries outside the United States will be curtailed by 10 per cent. The Rhokana Corporation will from July 1 be allowed to produce, in addition to its basic quota, an additional 952 tons per month, subject to the cut in the quota. As the result of the cut, the output of copper will be lowered by about 10,000 tons per month. Although it had been expected that some such move as this would have to be made, it had not been anticipated that a cut would be brought into operation at such an early date. However, it will be generally welcomed. The summer months are normally quiet for consumers of copper and so little inconvenience is likely to result from the reduced production. The weekly market report issued by Brandeis, Goldschmidt & Company, Limited, states that "standard copper has been a fairly steady market with a firm undertone. The demand for copper from countries outside the United States continues to keep pace with the corresponding production. Whether this rate of consumption can continue is a little doubtful, but it is to be hoped that any falling off will be made good by a greater improvement in America. Some purchases of standard have been made against forward sales of refined copper." Customs smelters in the United States have raised the price of scrap copper to 7¼ cents per lb.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £33 15s. to £33 16s. 3d.; Friday, £33 17s. 6d. to £33 18s. 9d.; Monday, £34 13s. 9d. to £34 15s.; Tuesday, £36 2s. 6d. to £36 3s. 9d.; Wednesday, £36 3s. 9d. to £36 6s. 3d.

Three Months.—Thursday, £33 18s. 9d. to £34 1s. 3d.; Friday, £34 2s. 6d. to £34 3s. 9d.; Monday, £34 18s. 9d. to £35; Tuesday, £36 7s. 6d. to £36 8s. 9d.; Wednesday, £36 8s. 9d. to £36 10s.

Tin.—Owing to the uncertain state of the market, generally, consumers continue to pursue a cautious policy with regard to new buying. Mr. Archibald G. G. Glenister, one of the three Malayan delegates on the International Tin Committee, has resigned from that body as a protest against the treatment accorded to Malaya. Regret at the step which Mr. Glenister has taken has been expressed in Malaya, where his technical abilities are highly valued. In a cable to the F.M.S., Mr. Glenister states that he could not associate himself with the decision in regard to revision of standard tonnages taken against the advice of himself and the adviser at the Paris meeting. It is rumoured that Mr. Lowinger, another Malayan delegate, may also shortly resign from the Committee, but it is stressed that this has nothing to do with recent controversies.

At Monday's meeting in London of the International Tin Committee the quota for the third quarter of the year was fixed at 35 per cent. of standard tonnages, which have been augmented in the cases of Malaya and the Netherlands East Indies by 7½ per cent. The Committee discussed, and settled, a revised draft of the buffer stock scheme, which will be published as soon as possible. There are no material variations as compared with the original draft. The contribution of the buffer stock to the third-quarter quota has been fixed at 10 per cent., as had been generally forecast. The next meeting of the Committee will be held on September 14 at The Hague.

The report of the London Tin Corporation states that the feature of the year in Malaya has been the intense effort devoted to new equipment and to the reconditioning of the plant in charge of the Corporation. Intensive prospecting in Malaya has been continued by Anglo-Malayan Development, a wholly-owned subsidiary. Total profits increased during the year by £16,700 to £344,083.

Official quotations were as follow :—

Cash.—Thursday, £173 15s. to £174; Friday, £178 10s. to £178 15s.; Monday, £181 10s. to £182; Tuesday, £184 to £184 5s.; Wednesday, £187 5s. to £187 15s.

Three Months.—Thursday, £174 10s. to £174 15s.; Friday, £179 5s. to £179 10s.; Monday, £182 10s. to £182 15s.; Tuesday, £185 to £185 5s.; Wednesday, £188 5s. to £188 10s.

Spelter.—This market remains very quiet. Consumers are displaying little interest in the market as far as new business is concerned and there appear to be no better prospects for a considerable time ahead.

Daily market prices :—

Ordinary.—Thursday, £12 7s. 6d.; Friday, £12 8s. 9d.; Monday, £12 13s. 9d.; Tuesday, £13 1s. 3d.; Wednesday, £13 8s. 9d.

Lead.—Consumption of this metal continues to fall away and consuming industries, generally, are badly situated for work. The Ministry of Labour reports that building plans approved in May totalled £9,045,900, against £9,095,400 in the corresponding month of last year. The May returns were much better compared with recent figures and showed an increase of 6.6 per cent. on the previous month.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £13 8s. 9d.; Friday, £13 8s. 9d.; Monday, £13 17s. 6d.; Tuesday, £14 7s. 6d.; Wednesday, £14 16s. 3d.

Scrap.—Little business has been reported this week and the tone of the scrap market remains dull.

Approximate selling prices for old metal :—New aluminium cuttings, £75; rolled, £58; cast, £28; foil, £86. Copper, £31 to £34; braziery, £27 to £28. Brass (clean), £19 to £23. Zinc, £7. Lead, £11. Gunmetal, £35.

Surface Protection of Magnesium and Its Alloys

A writer in "Giessereipraxis" refers to a new process covered by an Austrian Patent (No. 149,342) granted to the Austro-American Magnesite Company. This consists in the use of organic material as a covering for the metal bath, such material being capable of being burnt and thereby first producing smoke and then leaving a solid crust to float on top of the metal. Such an action gives adequate covering to the surface of the bath and prevents the formation of oxides and nitrides, especially as the crust is not wet by the liquid metal. The organic materials suggested are asphalt; casein; animal charcoal and sugar, used either separately or as admixtures. These materials are charged into the crucible at an appropriate time and on them are added an organic salt, preferably fluorspar or magnesite, but not chlorides. When casting, the solid crust leaves the sides of the crucible, but does not crumble. By this means, alloys free from chlorides are regularly produced. A mixture recommended is two parts of fluorspar to one of animal charcoal, 2 per cent. by weight of this mixture being used, related to the weight of metal melted.

RAW MATERIALS—PRICE LIST

(Wednesday, June 22, 1938)

COPPER

	£	s.	d.
Standard cash	36	3	9
Three months	36	8	9
Electrolytic	40	15	0
Tough	39	5	0
Best selected	39	15	0
Sheets	70	0	0
India	52	7	6
Wire bars	41	0	0
Ingot bars	41	0	0
H.C. Wire rods	44	10	0
Off. av. cash, May	36	14	$2\frac{5}{11}$
Do., 3 mths., May	36	19	$0\frac{9}{22}$
Do., Sttlmnt., May	36	14	$2\frac{5}{11}$
Do., Electro, May	41	5	$1\frac{3}{11}$
Do., B.S., May	40	15	10
Do., Wire bars, May	41	13	$2\frac{2}{11}$
Solid drawn tubes			$11\frac{1}{2}$d.
Brazed tubes			$11\frac{1}{2}$d.
Wire			$7\frac{1}{2}$d.

BRASS

Solid drawn tubes	$10\frac{1}{2}$d.
Brazed tubes	$12\frac{1}{2}$d.
Rods, drawn	$8\frac{1}{2}$d.
Rods, extd. or rlld.	6d.
Sheets to 10 w.g.	8d.
Wire	$7\frac{1}{2}$d.
Rolled metal	$7\frac{1}{2}$d.
Yellow metal rods	6d.

TIN

	£	s.	d.
Standard cash	187	5	0
Three months	188	5	0
English	187	5	0
Bars	189	5	0
Straits	190	5	0
Eastern	189	15	0
Banca (nom.)			—
Off. av. cash, May	162	16	$8\frac{5}{11}$
Do., 3 mths., May	163	8	9
Do., Sttlmt., May	162	16	$9\frac{9}{11}$

SPELTER

	£	s.	d.
Ordinary	13	8	9
Remelted	10	5	0
Hard	9	15	0
Electro, 99.9	17	6	3
English	14	7	6
India	13	0	0
Zinc dust	18	5	0
Zinc ashes	5	10	0
Off. aver., May	12	15	$6\frac{31}{32}$
Aver., spot, May	12	13	$7\frac{7}{11}$

LEAD

	£	s.	d.
Soft foreign, ppt.	14	16	3
Empire (nom.)	15	3	9
English	17	0	0
Sheets, home	21	0	0
Do. export	17	10	0
Pipes, home	20	10	0
Do. export	18	2	6
Tea lead	29	15	0
Off. aver., May	14	5	$10\frac{25}{32}$
Aver., spot, May	14	4	$2\frac{5}{11}$

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English	27 15 0 to 28	5	0
Do., V.M. ex-whse.	27 15 0 to 28	5	0
Rods	19	10	0

ANTIMONY

English	70 0 0 to 71	0	0
Chinese, ex-whse.	51	10	0
Crude, c.i.f.	30	0	0

QUICKSILVER

Quicksilver	13	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—			
25%	12	10	0
45/50%	12	10	0
75%	17	0	0
Ferro-vanadium—			
35/50%	14/- lb. Va.		
Ferro-molybdenum—			
70/75% carbon-free	4/9 lb. Mo.		
Ferro-titanium—			
20/25% carbon-free	9d. lb.		
Ferro-phosphorus, 20/25%	£21 to £22		
Ferro-tungsten—			
80/85%	4/8 lb.		
Tungsten metal powder—			
98/99%	4/9½ lb.		
Ferro-chrome—			
2/4% car.	34	15	0
4/6% car.	24	5	0
6/8% car.	24	0	0
8/10% car.	24	0	0
Ferro-chrome—			
Max. 2% car.	36	0	0
Max. 1% car.	38	5	0
Max. 0.5% car.	41	0	0
70% carbon-free	10d. lb.		
Nickel—99.5/100%	£180 to £185		
"F" nickel shot	£165	0	0
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.		
Metallic chromium—			
96/98%	2/5 lb.		
Ferro-manganese—			
76/80% loose	£18 15 0 to 19	5	0
76/80% packed	£19 15 0 to 20	5	0
76/80% export	£15 0 0 to 17	0	0
Metallic manganese—			
94/96% carbon-free	1/3 lb.		

Per ton unless otherwise stated, basis 2-ton lots.

SCRAP

	£	s.	d.	£	s.	d.
South Wales (West)—						
Heavy steel, best	3	8	9 to	3	11	3
Mixed iron and steel	3	6	9 to	3	9	3
Heavy cast iron	3	8	9 to	3	11	3
Good machinery				3	10	0
Cleveland—						
Heavy steel, best	3	7	0 to	3	9	6
Steel turnings	2	13	0 to	2	15	6
Heavy cast iron				3	10	0
Heavy machinery				3	15	0
Midlands—						
Short heavy steel				3	12	6
Light cast-iron scrap				3	2	6
Heavy wrought iron	4	0	0 to	4	5	0
Steel turnings	2	6	3 to	2	8	9
Scotland—						
Heavy steel best	3	5	0 to	3	7	6
Ordinary cast iron	3	11	3 to	3	12	6
Cast-iron borings	2	0	6 to	2	3	0
Wrot-iron piling	3	15	0 to	3	17	6
Heavy machinery	3	13	6 to	3	16	3

London—Merchants' buying prices, delivered yard.

Copper (clean)	27	0	0
Brass	17	0	0
Lead (less usual draft)	11	10	0
Tea lead	8	0	0
Zinc	6	10	0
New aluminium cuttings	65	0	0
Braziery copper	23	0	0
Gunmetal	28	0	0
Hollow pewter	120	0	0
Shaped black pewter	80	0	0

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 0d.
Finished bars, 18% tungsten	3s. 10d.

Per lb. d/d buyers' works.

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	111/6
„ No. 3	109/-
„ No. 4	108/-
Forge No. 4	108/-
Hematite No. 1	133/-
Hematite M/Nos.	132/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	133/-
„ d/d Birm.	144/6
Malleable iron d/d Birm.	160/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	110/-
„ No. 3 fdry.	111/-
Northants forge	107/6
„ fdry. No. 3	108/6
„ fdry. No. 1	111/6
Derbyshire forge	110/-
„ fdry. No. 3	111/-
„ fdry. No. 1	114/-
Scotland—	
Foundry, No. 1, f.o.t.	120/6
„ No. 3, f.o.t.	118/-
Cleveland No. 3, Glasgow	112/-
„ Falkirk	109/-
Scottish hem. M/Nos. d/d	133/-
Sheffield (d/d district)—	
Derby forge	107/6
„ fdry. No. 3	108/6
Lincs forge	107/6
„ fdry. No. 3	108/6
W.C. hematite	138/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	114/-
Staffs fdry. No. 3	114/-
Northants fdry. No. 3	112/6
Cleveland fdry. No. 3	114/-
Glengarnock, No. 3	137/6
Clyde, No. 3	137/6
Monkland, No. 3	137/6
Eglinton, No. 3	137/6
Gartsherrie, No. 3	137/6
Shotts, No. 3	137/6

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	13	5	0 to	13	15	0
Nut and bolt iron	11	12	6 to	12	2	6
Hoops				14	2	6
Marked bars (Staffs) f.o.t.				15	15	0
Gas strip				14	2	6
Bolts and nuts, ¾ in. × 4 in.				17	10	0 and up
Steel—						
Plates, ship, etc.	11	8	0 to	11	10	6
Boiler plts.	11	18	0 to	12	0	6
Chequer plts.				13	0	6
Angles				11	0	6
Tees				12	0	6
Joists				11	0	6
Rounds and squares, 3 in. to 5½ in.				12	0	6
Rounds under 3 in. to ⅜ in. (untested)				12	4	0
Flats—8 in. wide and over				11	5	6
„ under 8 in. and over 5 in.				11	10	6
Rails, heavy				10	2	6
Fishplates				14	2	6
Hoops (Staffs)				12	19	0
Black sheets, 24g. (4-t. lots)				15	15	0
Galv. cor. shts. („)				18	10	0
Galv. flat shts. („)				19	0	0
Galv. fencing wire, 8g. plain				20	5	0
Billets, soft, 100-ton lots				7	17	6
Sheet bars				7	15	0
Tin bars				7	15	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	$10\frac{1}{2}$d.
Sheet to 10 w.g.	$10\frac{1}{2}$d.
Wire	$12\frac{1}{2}$d.
Rods	$12\frac{1}{2}$d.
Tubes	$17\frac{1}{2}$d.
Castings	15d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.84
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	40/- to 42/6
„ furnace	32/6
Durham foundry	34/6
„ furnace	30/-
Scottish foundry	40/-
„ furnace	35/-

TINPLATES

f.o.b. British Channel ports.

I.C. cokes	20×14 per box	20/3 to 21/6
„	28×20 „	40/6 to 43/-
„	20×10 „	29/-
„	18¾×14 „	21/-
C.W.	20×14 „	19/- to 20/3
„	28×20 „	38/- to 40/6
„	20×10 „	27/-
„	18¾×14 „	19/9

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£11	0	0 to	£12	0	0
Bars-hammered, basis	£20	0	0 to	£22	0	0
Bars and nail-rods, rolled, basis	£19	0	0 to	£20	0	0
Blooms	£18	0	0 to	£19	0	0
Keg steel	£30	0	0 to	£35	0	0
Faggot steel	£19	0	0 to	£24	0	0
Bars and rods dead soft st'l	£13	0	0 to	£15	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£	s.	d.		
June 16 ..	33	15	0	dec.	3/9
„ 17 ..	33	17	6	inc.	2/6
„ 20 ..	34	13	9	„	16/3
„ 21 ..	36	2	6	„	28/9
„ 22 ..	36	3	9	„	1/3

Electrolytic Copper

	£	s.	d.		
June 16 ..	38	5	0	dec.	5/-
„ 17 ..	38	5	0	No	change
„ 20 ..	39	0	0	inc.	15/-
„ 21 ..	40	0	0	„	20/-
„ 22 ..	40	15	0	„	15/-

Standard Tin (cash)

	£	s.	d.		
June 16 ..	173	15	0	inc.	50/-
„ 17 ..	178	10	0	„	95/-
„ 20 ..	181	10	0	„	60/-
„ 21 ..	184	0	0	„	50/-
„ 22 ..	187	5	0	„	65/-

Tin (English ingots)

	£	s.	d.		
June 16 ..	173	15	0	inc.	50/-
„ 17 ..	178	10	0	„	95/-
„ 20 ..	181	10	0	„	60/-
„ 21 ..	184	0	0	„	50/-
„ 22 ..	187	5	0	„	65/-

Spelter (ordinary)

	£	s.	d.		
June 16 ..	12	7	6	inc.	1/3
„ 17 ..	12	8	9	„	1/3
„ 20 ..	12	13	9	„	5/-
„ 21 ..	13	1	3	„	7/6
„ 22 ..	13	8	9	„	7/6

Spelter (Electro, 99.9 per cent.)

	£	s.	d.		
June 16 ..	16	5	0	inc.	1/3
„ 17 ..	16	6	3	„	1/3
„ 20 ..	16	11	3	„	5/-
„ 21 ..	16	18	9	„	7/6
„ 22 ..	17	6	3	„	7/6

Lead (soft foreign, prompt)

	£	s.	d.		
June 16 ..	13	8	9	inc.	2/6
„ 17 ..	13	8	9	No	change
„ 20 ..	13	17	6	inc.	8/9
„ 21 ..	14	7	6	„	10/-
„ 22 ..	14	16	3	„	8/9

Lead (English)

	£	s.	d.		
June 16 ..	15	10	0	inc.	5/-
„ 17 ..	15	10	0	No	change
„ 20 ..	16	0	0	inc.	10/-
„ 21 ..	16	10	0	„	10/-
„ 22 ..	17	0	0	„	10/-

Imports and Exports of Pig-iron, Castings, etc., in May and the Five Months 1938, compared with May and the Five Months 1937

	May.		Five months.		May.		Five months.	
	1937.	1938.	1937.	1938.	1937.	1938.	1937.	1938.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Imports.								
Pig-iron—from British India	11,029	13,334	65,133	105,550	38,858	64,373	224,685	527,618
„ „ Other British Countries	—	—	5,041	—	—	—	21,047	—
„ „ Foreign Countries	13,464	6,556	32,105	202,458	78,117	63,955	187,245	1,119,056
Total	24,493	19,890	102,279	308,008	116,975	128,328	432,977	1,646,674
Castings and forgings	127	278	1,049	2,072	5,259	8,923	32,510	71,536
Cast pipes and fittings	75	36	416	383	2,571	1,212	11,904	11,955
Stoves, grates, etc.	48	69	258	315	6,974	6,838	36,646	31,156
Baths	1,026	563	4,260	2,967	25,027	14,929	101,984	76,641
Hollow-ware, all kinds	260	281	1,444	1,484	16,096	18,982	86,585	94,462
Exports.								
Pig-iron, forge and foundry	7,540	3,675	44,609	22,001	43,576	26,958	219,640	155,474
„ acid	5,971	1,671	26,644	12,592	33,967	11,192	138,608	92,668
„ basic	102	—	496	5	457	—	2,886	40
Total	13,613	5,346	71,749	34,598	78,000	38,150	361,134	248,182
Castings and forgings	385	167	1,422	847	14,041	7,502	52,282	36,354
Cast pipes and fittings, up to 6 in. diameter	6,331	3,428	25,223	20,378	65,105	49,131	266,904	263,015
„ „ „ over 6 in. „	4,155	2,219	16,830	21,063	31,835	24,012	131,554	218,403
Stoves, grates, etc.	973	686	4,979	3,652	51,164	40,540	262,772	208,689
Sanitary cisterns	345	164	1,562	1,136	12,256	6,297	51,555	44,131
Bedsteads, including tubes therefor	607	146	2,544	962	21,340	7,672	94,254	44,806
Hollow-ware	391	170	2,218	1,196	14,959	9,958	76,656	56,599

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FOUNDRY MANAGER desires change. Excellent records reorganising and development; also technical and business experience. Iron, brass, patternshop, general engineering or mass-production castings. Guarantee results. Would consider position home or abroad.—Box 974, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY MANAGER desires change. Wide experience as manager in light-castings and engineering repetition work, also in control of general foundries. South technical training, excellent credentials. (324)

SITUATIONS VACANT AND WANTED—*Contd.*

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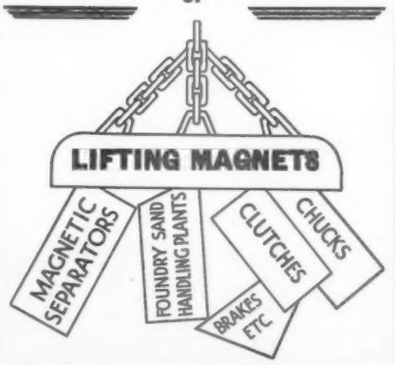

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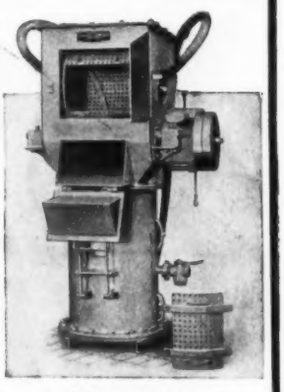

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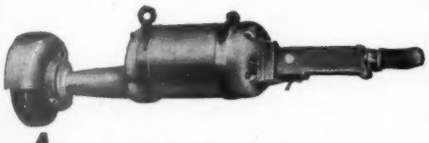

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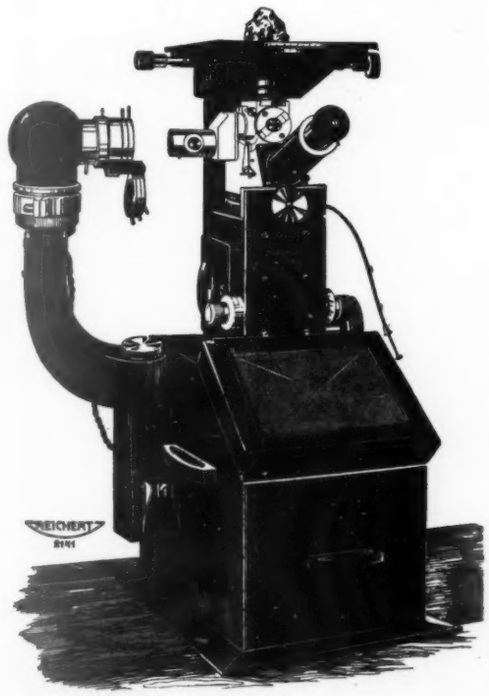

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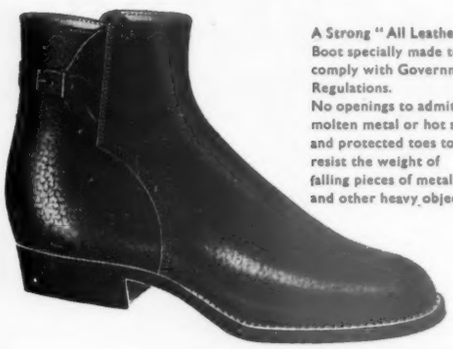

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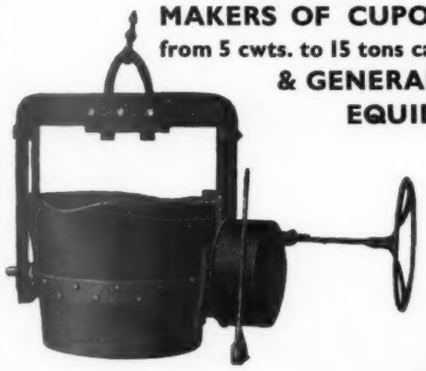
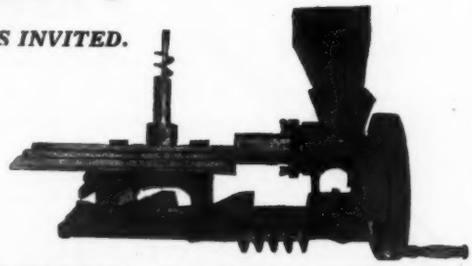


ENQUIRIES INVITED.



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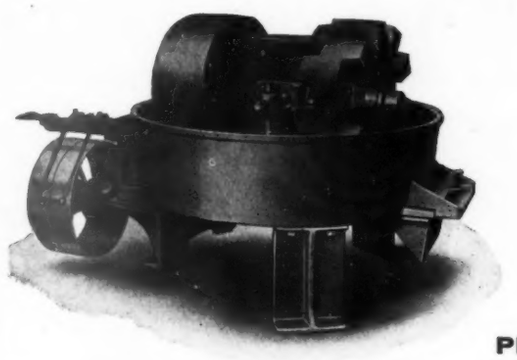

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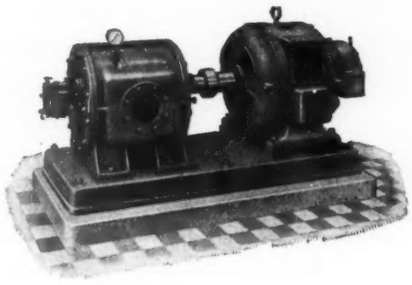

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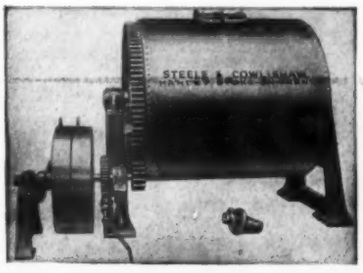

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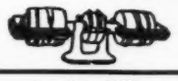

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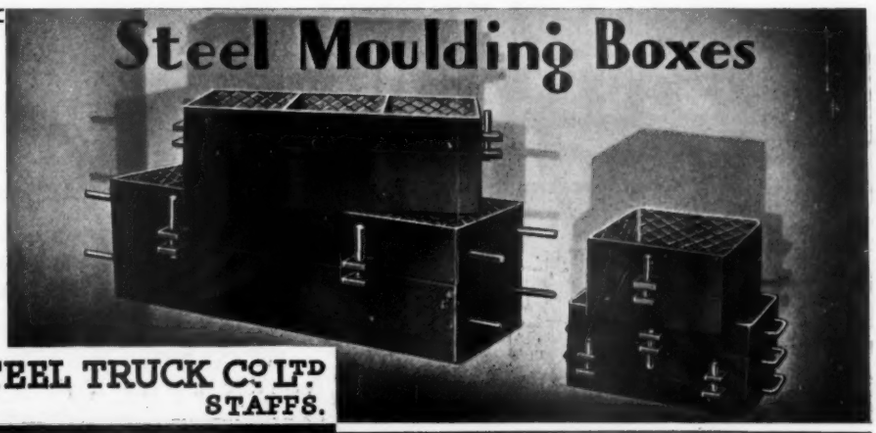

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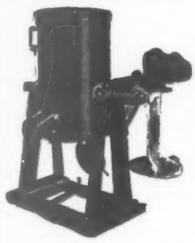

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Carbon (graphitic)	3·20	3·00	3·50	3·70	3·50	3·25	3·10	2.80
,, (combined)	0·30	0·40	0·04	0·08	0·12	0·24	0·30	0·50
Silicon	2·0 to 3·0	2·0 to 3·0	4·0 to 5·0	2·5 to 4·0	2·5 to 4·0	2·0 to 4·0	2·0 to 3·5	2·0 to 3·0
Sulphur	0·03	0·04	0·01	0·01	0·02	0·03	0·04	0·06 to 0·08
Phosphorus	0·75	0·75	1·4 to 1·5	1·4 to 1·5	1·4 to 1·5	1·4 to 1·5	1·4 to 1·5	1·4 to 1·5
Manganese	1·3 to 1·5	1·2 to 1·4	0·8 to 1·4	0·8 to 1·4	0·8 to 1·4	0·8 to 1·4	0·8 to 1·4	0·8 to 1·2

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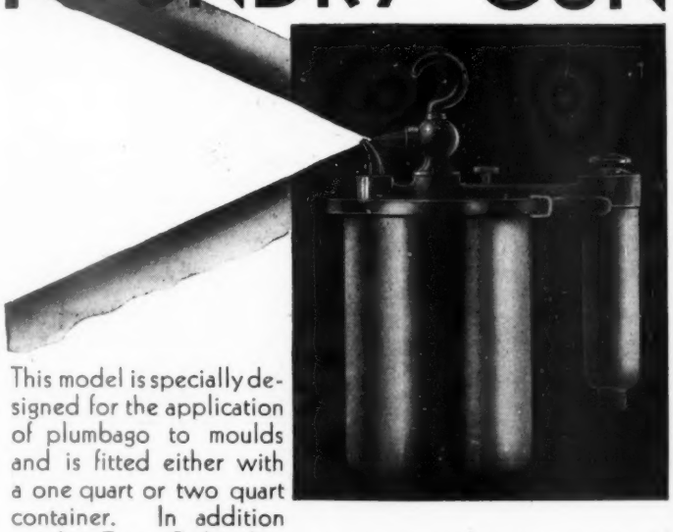

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